KALRO
Kenya Agricultural & Livestock Research Organization

KCSAP
Kenya Climate Smart Agriculture Project

Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for African Indigenous Vegetables (AIVs) Value Chain

VOLUME III: NIGHTSHADE, JUTE MALLOW AND SLENDAR

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DISCLAIMER

The information presented in this inventory of Technologies, Innovations and Management Practices (TIMPs) book is for advisory use only. Users of this book should verify site specific details that relate to their agro-climatic zones from their area agricultural extension officers.

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FOREWORD

Kenya Climate-Smart Agriculture Project (KCSAP) tasked the Kenya Agricultural and Livestock Research Organization (KALRO) with the implementation of the project's Component 2 on 'Strengthening Climate-Smart Agricultural Research and Seed Systems'. The component activities are geared towards the development, validation, adoption and delivery of context specific climate smart agriculture (CSA) technologies, innovation and management practices (TIMPs). It is also responsible for development of sustainable seed production and distribution systems of priority agricultural value chains to enhance availability and access improved seeds, animal breeds and fingerlings by target beneficiaries. Against this background, KALRO and her National Agricultural Research System (NARS) partners have developed, validated and availed CSA TIMPs for dissemination and adoption. This document provides a detailed inventory of TIMPs that have been developed in African Indigenous Vegetables (AIVs) value chain.

Extensive information from research and background data has been used to develop this TIMPs inventory. To disseminate the TIMPs, a Training of Trainers (ToT) manual has been developed. The design of the manual takes into consideration the delivery system, partners and their roles, duration of training and logical flow of the modules. The training modules have uniform outline that ensures every aspect of the TIMPs are fully covered in way that the trainees can absorb and relate to. Various delivery methods are deployed and where possible demonstrations and practical work are incorporated to enable the trainees learn by participating in the actual field activities. The use of this TIMPs inventory is expected to contribute to achievement of the envisaged KCSAP's project 'Triple Wins' of increased productivity, enhanced resilience and reduction of greenhouse gases emissions. Thus, this TIMPs inventory is to be used in conjunction with the respective AIVs ToT Manual.

Finally, I am greatly indebted to the value chain leaders and all those who participated in the preparation of this inventory of TIMPs. It is expected to herald new ways of delivering training content that will enable realization of the project objectives and aspirations.

Eliud K. Kireger, PhD, OGW
Director General, KALRO

PREFACE

The Kenya Climate-Smart Agriculture Project (KCSAP) is a Government of Kenya project with support from both the World Bank and the government. The project runs for five years and implemented in 24 counties, mainly in the arid and semi-arid lands (ASALs), at an approximate cost of KES 25 billion. The project development objective (PDO) is "to increase agricultural productivity and build resilience to climate change risks in the targeted smallholder farming and pastoral communities, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response." This objective is to be achieved through the implementation of five key components, which are: 1) Upscaling Climate-Smart Agricultural Practices, 2) Strengthening Climate-Smart Agricultural Research and Seed Systems, 3) Supporting Agro-weather, Market, Climate, and Advisory Services, 4) Project Coordination and Management and 5) Contingency Emergency Response.

Component 1 involves facilitating the empowering of farmers and communities to adopt technologies, innovations and management practices (TIMPs) to achieve the Climate Smart Agriculture (CSA) triple-wins of; increased productivity, enhanced resilience (adaptation), and reduced Greenhouse gas (GHG) emissions (mitigation). Component 2 is tasked with the responsibility of providing the TIMPs. Therefore, it supports the development, validation, and adoption of context specific CSA TIMPs to target beneficiaries under Components 1 and 3.

To catalyze uptake of TIMPs, Kenya Agricultural and Livestock Research Organization (KALRO) in conjunction with partners in the National Agricultural Research Systems (NARS) and Consultative Group for International Agricultural Research (CGIAR) compiled inventories of TIMPs for the prioritized value chains. The crop-based value chains are 19 and include roots and tubers (cassava, potato), pulses (dry beans, green gram and pigeon peas), vegetables (tomato, onion, indigenous vegetables, kale and mango), cereals (sorghum, millet, maize, teff) nuts (mango nut), fruits (banana, mango, water melon) and fibre (cotton). Those that are animal production based are five (5) and include apiculture, indigenous chicken (meat and eggs), dairy (cattle and camel), red meat (cattle, sheep and goats) and aquaculture. Also, there are three (3) cross cutting themes on pastures and fodder, natural resource management, and animal health. The TIMPs have been categorized into those ready for upscaling and those requiring validation. Furthermore, gaps that required further research and development of TIMPs have been identified. Training of Trainers' (ToT) manuals focusing on TIMPs that are ready for upscaling for each of the value chains have been subsequently developed to form the basis of training county extension staff, service providers and lead farmers. Those trained are in turn expected to cascade the training to beneficiaries in the targeted smallholder farming, agro-pastoral and pastoral communities in the 24 project counties of Marsabit, Isiolo, Tana River, Garissa, Wajir, Mandera, West Pokot, Baringo, Laikipia, Machakos, Nyeri, Tharaka Nithi, Lamu, Taita Taveta, Kajiado, Busia, Siaya, Nyandarua, Bomet, Kericho, Kakamega, Uasin Gishu, Elgeyo Marakwet and Kisumu.

KALRO, having the responsibility of implementing the activities under Component 2, has been instrumental in using its information resources and those of partners and collaborators to come up with the inventories of TIMPs and corresponding ToT manuals. Use of these information resources coupled with the accompanying training and contribution of the other project components will go a long way in enabling KCSAP to meet its development objectives.

The National Project Coordination Unit is grateful to all who participated in the development and production of this TIMPs inventory for AIVs value chain. It is my hope that counties and other users will put this resource to good use as they transform and reorient their agricultural systems to make

them more productive and resilient while minimizing GHG emissions under the new realities of the changing climate.

John Nginyangi
National Project Coordinator
Kenya Climate-Smart Agriculture Project

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ABBREVIATIONS AND ACRONYMS

AEZ	agro ecological zone
AIP	Agricultural Innovation Platform
AIV	African Indigenous Vegetables
ASALs	Arid and Semi-Arid Lands
B	Boron
CA	Conservation Agriculture
Ca	Calcium
CAN	Calcium Ammonium Nitrate
CBO	Community Based Organization
CCP	critical control points
CCT	county coordinating teams
CGIAR	Consultative Group for International Agricultural Research
CIG	common interest groups
Cl	Chlorine
CSA	Climate Smart Agriculture
Cu	Copper
DAP	Di Ammonium Nitrate
EMSF	Environmental Social Management Framework
ET	Evapotranspiration
Fe	Iron
FSMS	food safety management system
GAP	Good Agronomic Practices
GHG	Greenhouse gas
GoK	Government of Kenya
HACCP	hazard analysis critical control points
INRM	integrated natural resource management
IDM	Integrated Disease Management
IPM	Integrated Pest Management
IWM	Integrated Weed Management
ISFM	integrated soil fertility management
K	Potassium
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KCSAP	Kenya Climate Smart Agriculture Project
KEPHIS	Kenya Plant Health Inspectorate Services
KES	Kenya Shilling
Kg	Kilogram
JKUAT	
LF	Lead Farmers
Mg	Magnesium
Mo	Molybdenum
N	Nitrogen
NARS	national agricultural research systems
NGO	Non-Government Organization
NPK	Nitrogen Phosphorus Potassium
P	Phosphorus
PDO	Project development objective
PTD	Participatory Technology Development

S	Sulphur
TIMPs	Technology Innovation and Management Practices
TOTs	Training of Trainers
VMG	vulnerable and marginalized group
Zn	Zinc

5.0 African Nightshade TIMPs

5.1 Improved African Nightshade KK Bigi

TIMPS name	KK Bigi
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low yields
What is it? (TIMP description)	An improved African nightshade variety released in 2017, Has large green leaves, is high yielding (15 t/ha^{-1}) and can be harvested for 2 months. Very nutritious and rich in calcium, zinc and magnesium. Has a mild taste. area of production is 250-2000 masl
Justification 	African nightshades one of the popular African leafy vegetables. The commonly found local land races have tiny leaves are bitter especially for the youth and low yielding. The new variety yields higher than the local one because it has larger leaves and can be harvested over a longer period It is mild in taste and can be consumed by children and the young It commands a wider market and is good for income generation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Consumers, farmers, extension service providers, seed companies, researchers and traders
Approaches used in dissemination	Farmer field days, shows and exhibitions, demonstrations, farmer trainings, media, promotional materials
Critical/essential factors for successful promotion	Improved varieties with mild taste has increased acceptability of nightshade, hence the demand Reliable market outlets as such as supermarkets, hotels and hospital
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Kakamega and Nyamira

Challenges in development and dissemination	Adequate seed
Suggestions for addressing the challenges	Rapid multiplication of seed using farmer groups
Lessons learned in up scaling, if any	- Farm yard manure key in production of nightshades. - Consumers prefer mild types (mild taste) to bitter types -Improved varieties with bigger leaves preferred by consumers since less time is spent on preparation and cooking
Social, environmental, policy and market conditions necessary for development and up-scaling	ing of developed technologies (Varieties) and agronomic packages place an efficient seed system place an advisory on safe use of pesticides (reports from Western indicate that farmers imported chemicals illegally from a buring country which had a negative effect on consumers ze the community on dangers of across border trade in sub-standard mful chemicals. ensitization on commercial benefits of AIVs (still considered a ence crop hence still grown in kitchen gardens.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination, adoption and scaling up	• Night shade can be grown in a small piece of land hence it is suitable for women and the youth • Women have been planting poor quality seeds of night shade leading to lack of information on existing night shade improved varieties • Women have limited access to education, training and extension services than men hence might not have information on improved African Nightshade KK Bigi variety • Women have no funds to purchase seeds of improved African Nightshade KK Bigi variety • Nightshade is an entirely a woman's enterprise therefore competing for the woman's labour with other crops such as maize in addition to her domestic roles
Gender related opportunities	• Improved African Nightshade KK Bigi variety has the potential of improving production creating employment for women and youth at every node of the value chain • Improved African Nightshade KK Bigi variety has the potential of providing food and nutritional security for households • The improved African Nightshade KK Bigi variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for women and youth

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to education, training and extension services hence might not have information on improved African Nightshade KK Bigi variety • VMGs have no funds to purchase seeds of improved African Nightshade KK Bigi variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either sickness, disability or lack of exposure hence they might not have access to improved African Nightshade KK Bigi variety seeds • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• Improved African Nightshade KK Bigi variety has the potential of improving production creating employment for VMGs every node of the value chain • Improved African Nightshade KK Bigi variety has the potential of providing food and nutritional security for VMG households • The improved African Nightshade KK Bigi variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for VMGs
E: Case studies/profiles of success stories	
Success stories	Women groups in Nandi South and Busia are growing AIVs for commercial purposes and their own consumption
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRRO Kakamega, P. O. Box 169-50100, Kakamega , Kenya
Lead organization and scientists	KALRO; C. Ndinya, M. Odendo, P. Omolo.
Partner organizations	Ampath Moi Referral Hospital, University of Eldoret, World Vegetable Centre

Improved African Nightshade KK Ayaro

TIMPS name	**KK Ayaro**

Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of improved varieties, low yields
What is it? (TIMP description) 	Has large green leaves It is high yielding (15 t/ha^{-1}) It is early maturing short harvesting period Very nutritious and rich in calcium, iron, magnesium, Has mild taste
Justification	The local land races commonly found are low yielding and not appealing in tast to the majoriy of the population who are youth. The variety is mild in taste, fast growing and establishes easily. Suitable for farmers who harvest once for the markets. High yielding and suitable for income generation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, Women groups, youth, extension service providers, farmer groups, researchers, traders
Approaches used in dissemination	Training materials, farmer field days, shows and exhibitions, demonstrations, farmer trainings, social media, mass media.
Critical/essential factors for successful promotion	Improved varieties with mild taste has increased acceptability of nightshade, hence the demand Reliable market outlets as such as supermarkets, hotels and hospitals Availability of high quality seeds.
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Kakamega
Challenges in development and dissemination	Seed availability. Limited knowledge of the variety
Suggestions for addressing the challenges	Increased seed production Sensitization of stakeholders on the variety

Lessons learned in up scaling, if any	- Farm yard manure key in production of nightshades. - Consumers prefer mild types (mild taste) to bitter types -Improved varieties with bigger leaves preferred by consumers since less time is spent on preparation and cooking
Social, environmental, policy and market conditions necessary for development and up-scaling	-Upscaling of developed technologies (Varieties) and agronomic packages -suitable environment for production of the variety. More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens. Policies that encourage the production of leaves and seeds Organized market for the AIVs
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	56,000 per acre
Estimated returns	30,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	• Night shade can be grown in a small piece of land hence it is suitable for women and the youth • Women have been planting poor quality seeds of night shade leading to lack of information on existing night shade improved varieties • Women have limited access to education, training and extension services than men hence might not have information on improved African Nightshade KK Ayaro variety • Women have no funds to purchase seeds of improved African Nightshade KK Ayaro variety • Nightshade is an entirely a woman's enterprise therefore competing for the woman's labour with other crops such as maize in addition to her domestic roles
Gender related opportunities	• Improved African Nightshade KK Ayaro variety has the potential of improving production creating employment for women and youth at every node of the value chain • Improved African Nightshade KK Ayaro variety has the potential of providing food and nutritional security for households • The improved African Nightshade KK Ayaro variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for women and youth

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to education, training and extension services hence might not have information on improved African Nightshade KK Ayaro variety • VMGs have no funds to purchase seeds of improved African Nightshade KK Bigi variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either sickness, disability or lack of exposure hence they might not have access to improved African Nightshade KK Ayaro variety seeds • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• Improved African Nightshade KK Ayaro variety has the potential of improving production creating employment for VMGs every node of the value chain • Improved African Nightshade KK Ayaro variety has the potential of providing food and nutritional security for VMG households • The improved African Nightshade KK Ayaro variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for VMGs
E: Case studies/profiles of success stories	
Success stories	Women groups in Korokocho (Nairobi) : Street boys who are growing vegetable for commercial purposes and their own consumption
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P. O. Box 169-50100, Kakamega , Kenya
Lead organization and scientists	KALRO; F. Omari, C. Ndinya
Partner organizations	Ampath Moi Referral Hospital, University of Eldoret, Chuka University, World Vegetable Centre

Improved African Nightshade Abuku mnavu

TIMPS name	Abuku mnavu-1

Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of improved varieties, low yields
What is it? (TIMP description)	Green Scrabrum High yielding (20-40 t/ha^{-1}) Maturity time 5 weeks, Harvesting duration 8 weeks Very high anti-oxidant activity Has a mild taste Released in 2016 Growing area 100-2500 masl
Justification	The African nightshade vegetable is popular but production cannot meet demand because of low yielding land races. The high nutrient values have created a high demand. The improved varieties are large leaved high yielding and mild in taste. The large leaves make vegetable preparation easy. The increased demand has made the varieties a good source of income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, seed growers, extension service providers, farmer groups, academicians, traders
Approaches used in dissemination	Training, farmer field days, Demonstrations, shows and exhibitions, media, promotion materials, Mass media, social media
Critical/essential factors for successful promotion	Seed availability Awareness creation of variety
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming),
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Kakamega
Challenges in development and dissemination	Inadequate seed Non availability of land
Suggestions for addressing the challenges	Use of farmer groups for rapid seed multiplication
Lessons learned in up scaling, if any	- Farm yard manure key in production of nightshades. - Consumers prefer mild types (mild taste) to bitter types

	-Improved varieties with bigger leaves preferred by consumers since less time is spent on preparation and cooking
Social, environmental, policy and market conditions necessary for development and up-scaling	Upscaling of developed technologies (Varieties) and agronomic packages Put in place an efficient seed system Put in place an advisory on safe use of pesticides (reports from Western Kenya indicate that farmers imported chemicals illegally from a neighbouring country which had a negative effect on consumers Sensitize the community on dangers of across border trade in sub-standard and harmful chemicals. More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Production of nightshade is economically viable although not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Night shade can be grown in a small piece of land hence it is suitable for women and the youth • Women have been planting poor quality seeds of night shade leading to lack of information on existing night shade improved varieties • Women have limited access to education, training and extension services than men hence might not have information on improved African Nightshade Abuku Mnavu1 variety • Women have no funds to purchase seeds of improved African Nightshade Abuku Mnavu 1 variety • Nightshade is an entirely a woman's enterprise therefore competing for the woman's labour with other crops such as maize in addition to her domestic roles
Gender related opportunities	• Improved African Nightshade Abuku Mnavu1 variety has the potential of improving production creating employment for women and youth at every node of the value chain • Improved African Nightshade Abuku Mnavu1 variety has the potential of providing food and nutritional security for households • The improved African Nightshade Abuku Mnavu 1 variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for women and youth

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to education, training and extension services hence might not have information on improved African Nightshade Abuku Mavu1 variety • VMGs have no funds to purchase seeds of improved African Nightshade KK Bigi variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either sickness, disability or lack of exposure hence they might not have access to improved African Nightshade Abuku Mnavu1 variety seeds • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• Improved African Nightshade Abuku Mnavu1 vriety has the potential of improving production creating employment for VMGs every node of the value chain • Improved African Nightshade Abuku Mnavu1 variety has the potential of providing food and nutritional security for VMG households • The improved African Nightshade Abuku Mnavu1 variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for VMGs
E: Case studies/profiles of success stories	
Success stories	Women groups in Nandi south and Busia for commercial purposes and home consumption
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRRO Kakamega, P. O. Box 169-50100, Kakamega , Kenya
Lead organization and scientists	KALRO; F. Omari, C. Ndinya
Partner organizations	Ampath Moi Referral Hospital, University of Eldoret, Chuka University, World Vegetable Centre

GAPs

Improved African Nightshade Abuku Mnavu 2

TIMPS name	Abuku Mnavu2
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The commonly grown land races have low yields, are susceptible to soil borne diseases resulting in low productivity
What is it? (TIMP description)	○ High leaf yields (20-40 t/ha^{-1}) ○ Maturity time 5 weeks, ○ Harvesting duration 8 weeks ○ Very high anti-oxidant activity ○ Purple Scrabrum ○ Areas of production 250-2000 masl
Justification	○ Abuku Mnavu 2 is fast growing and establishes easily. Unlike the landraces that are low yielding and very susceptible to soilborne diseases ○ Abuku mnavu 2 variety can be grown throughout the year under irrigation. ○ The high yield and other positive attribues of the variety makes it suitable for income generation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, Women groups, youth, extension service providers, farmer groups, researchers, traders
Approaches used in dissemination	Training materials, farmer field days, shows and exhibitions, demonstrations, farmer trainings
Critical/essential factors for successful promotion	High demand for variety Reliable market outlets as such as supermarkets, hotels and hospitals Availability of high quality seeds.
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Mombasa, Kilifi, Taita Taveta, Kwale
Challenges in development and dissemination	Inadequate sensitization of the variety Lack of seed
Suggestions for addressing the challenges	Increased seed production Wider sensitization and promotion of the variety

Lessons learned in up scaling, if any	- Farm yard manure key in production of nightshades. - Consumers prefer mild types (mild taste) to bitter types -Improved varieties with bigger leaves such as Abuku manvu2 preferred by consumers since less time is spent on preparation and cooking
Social, environmental, policy and market conditions necessary for development and up-scaling	Increasing demand for developed technologies (Varieties) Growing variety in recommended environments Friendly policies that encourage More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Production of nightshade is economically viable although not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Night shade can be grown in a small piece of land hence it is suitable for women and the youth • Women have been planting poor quality seeds of night shade leading to lack of information on existing night shade improved varieties • Women have limited access to education, training and extension services than men hence might not have information on improved African Nightshade Abuku Mnavu2 variety • Women have no funds to purchase seeds of improved African Nightshade Abuku Mnavu2 variety • Nightshade is an entirely a woman's enterprise therefore competing for the woman's labour with other crops such as maize in addition to her domestic roles
Gender related opportunities	• Improved African Nightshade Abuku Mnavu2 variety has the potential of improving production creating employment for women and youth at every node of the value chain • Improved African Nightshade Abuku mnavu2 variety has the potential of providing food and nutritional security for households • The improved African Nightshade Abuku mnavu2 variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for women and youth

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to education, training and extension services hence might not have information on improved African Nightshade Abuku Mnavu2 variety • VMGs have no funds to purchase seeds of improved African Nightshade Abuku2 variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either sickness, disability or lack of exposure hence they might not have access to improved African Nightshade Abuku Mnavu2 variety seeds • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• Improved African Nightshade Abuku / variety has the potential of improving production creating employment for VMGs every node of the value chain • Improved African Nightshade Abuku2 variety has the potential of providing food and nutritional security for VMG households • The improved African Nightshade Abuku variety can be harvested over a long period hence provides stable vegetables for the market hence increased income for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRO Kakamega, P. O. Box 169-50100, Kakamega , Kenya
Lead organization and scientists	JKUAT: Prof. Mary Abukutsa
Partner organizations	JKUAT, World Vegetable Centre

GAPs

Required:

Identification of superior amaranth varieties

A reliable seed system

5.2 AIVs Seed systems: African night shade

TIMP Name	Formal African night shade seed system
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of African night shade is mainly due to low availability of diverse high-quality and locally adapted African night shade seed varieties. About 80% of African night shade seed is from informal seed system with no quality assurance.
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The formal African night shade seed system is characterized by a well-regulated and organized set of activities, from breeding to delivering certified seeds of known and registered varieties to farmers and other stakeholders. It ensures continuous production, processing, supply and distribution of quality African night shade seeds to farmers through organized marketing channels.
Justification	The formal seed system comprises registered seed producers or seed companies and the certification process, which is usually controlled by a public regulatory body (KEPHIS), thus assuring high seed quality for improved yield. Supply of good quality seeds strengthens the trust of farmers in seed producers and sellers and encourages variety adoption.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, traders • Research organizations and universities, Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs)
Approaches used in dissemination	• Training • Field days, exhibitions, seed fairs, demonstrations, agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche • Application of Participatory methods to promote the seed model and varieties • Offering seed at affordable prices • Organized African night shade product market

	• Strong Partnership of actors
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed, seed multiplication and technical backstopping • JKUAT: Breeders' seed, seed multiplication and technical backstopping • Seed companies: Seed multiplication, distribution and technical backstopping. • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs):: Seed multiplication and dissemination • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume African night shade products to create demand for African night shade seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed • World Vegetable Centre: Funding and technical backstopping
• **C: Current situation and future scaling up**	
Counties where already promoted. if any	• Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	• Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released. • Low availability of basic seed for multiplication of certified seed • Low demand for African night shade seeds: Most farmers recycle their own seed and cost of seed is high. • Poor quality/fake seed of African night shade from seed companies/agro dealers. • Most farmers not aware of potential of seed from formal seed systems.
Suggestions for addressing the challenges	• Lobbying for funding of African night shade research and multiplication of basic seed. • Multiplication of seed with farmer preferred traits and offered at affordable prices • KEPHIS to improve seed inspection in agro-dealer networks to ensure quality of African night shade seed and reduce sale of fake seed

	• Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.
Lessons learned in up scaling, if any	• Adoption of African night shade seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt. • Favourable agro-ecological conditions. • Availability of adequate market for African night shade seed and products. • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in African night shade production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • African night shade is considered women's crop. and requires low external resources for production. Most labour for African night shade production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of African night shade as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing African night shade productivity for food and nutrition security and income generation. In particular, production of African night shade is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies.

	• Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the African night shade. Youth could also benefit through application of ICT networking for marketing of African night shade. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter African night shades commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the African night shade. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. • Under the two projects, farmers in Nandi and Kakamega counties produced seed of AIVs species (Amaranth, spider plant, nightshade, cowpea, slender leaf, jute mallow) using both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels

	• National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems under KALRO SEED. Farmer groups in Vihiga county formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and sell in Nairobi
Application guidelines for users	• Leaflets on African night shade seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)—	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

1. Narrow range of varieties with market preferred traits
2. Low demand for AIVs seed from formal seed system

TIMP Name	Informal African night shade seed system
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of African night shade is mainly due to low availability of diverse high-quality and locally adapted African night shade seed varieties. About 80% of African night shade farmers grow seed from informal seed system with no quality assurance. Farmers have limited access to seed from formal seed sector due to high cost of the seed and limited varieties with desired traits
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The informal African night shade seed system entails seed selection, treatment, storage, multiplication, and distribution. The informal African night shade seed system is outside the control of government agencies, with no external seed quality control. This system includes farmer-saved seed, gifts, barter, exchange and seed purchasing from local markets.
Justification	Available African night shade seeds are predominantly Open-Pollinated Varieties (OPVs). The private sector has low incentive to produce the OPVs because farmers can recycle the varieties for several seasons without marked yield loss. The informal seed sector is justified for accessing African night shade seed due to

	low availability of improved varieties with desired traits and high cost of seed from formal sector.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, Traders, • Research organizations and universities, • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs)
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs Demonstrations, Agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche. • Application of Participatory methods to promote the seed model and varieties • Offering of seed at affordable prices • Organized African night shade product market • Strong partnership of actors
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume African night shade products to create demand for African night shade seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released

	• Low availability of basic seed for multiplication of certified seed • Quality of seed not assured • Low demand for African night shade seeds: Most farmers recycle their own seed and cost of seed is high. • .
Suggestions for addressing the challenges	• Lobbing for funding of African night shade research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices • Capacity building of farmers and farmer groups on high quality African night shade seed production • Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.
Lessons learned in up scaling, if any	• Adoption of African night shade seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Strong partnership linkages are important in seed technology dissemination and adoption • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt • Favourable agro-ecological conditions • Availability of adequate market for African night shade seed and products • Favorable policies and regulations to support informal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in African night shade production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • African night shade is considered women's crop. and requires low external resources for production. Most labour for African night shade production is provided by

	women; therefore, increased production is likely to provide employment to women. • With commercialization of African night shade as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing African night shade productivity for food and nutrition security and income generation. In particular, production of African night shade is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the African night shade. Youth could also benefit through application of ICT networking for marketing of African night shade. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter African night shades commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the African night shade. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.

E: Case studies/profiles of success stories	
Success stories	• No known case of successful informal African night shade seed system •
Application guidelines for users	• Leaflets on African night shade seed varieties available at KALRO-Kakamega.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

TIMP Name	Semi-Informal African night shade seed production system
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of African night shade is mainly due to low availability and limited access to diverse "high-quality locally adapted AIVs seed varieties to farmers and other stakeholders. In addition, farmers have limited knowledge and skills in seed selection, treatment, storage, multiplication, and distribution. Farmers' demand for seed from formal sectors is low due to several reasons including low availability, high cost and lack varieties with desired traits.
What is it? (TIMP description)	The semi-formal seed system (termed community-based) is at the interface of formal and informal seed systems. A community-based seed production system involves individual farmers or farmer groups or cooperatives producing quality seed of farmers and improved varieties (at testing and sensitization stage) using the formal seed production guidelines.
Justification	High quality seed is produced by a seed producer subject to quality control and complying with the minimum standards for the crop species concerned. The requirements for Semi-informal seed are less stringent than those of certified seeds while guaranteeing satisfactory seed quality. The cost of such seed is more farmer-friendly and varieties are produced according to farmer demands.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	• Farmers, Farmer groups • Seed companies • Agro-dealers, traders, • Research organizations and universities • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs) •
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs, Demonstrations, Agricultural shows , • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market nicheApplication of Participatory methods to promote the seed model and varieties • Offering of seed at affordable prices • Organized African night shade product market • Strong Partnership of actor
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume African night shade products to create demand for African night shade seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released

	• Low availability of basic seed for multiplication of certified seed • Low demand for African night shade seeds: Most farmers recycle their own seed and cost of seed is high. • Most farmers aware of potential of seed from semi-formal seed systems
Suggestions for addressing the challenges	• Lobbying for funding of African night shade research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices. • Sensitize farmers and other stakeholders on benefits of AIVs seed from semi-formal seed system.
Lessons learned in up scaling, if any	• Adoption of African night shade seeds from informal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption. • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption. • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt • Favourable agro-ecological conditions • Availability of adequate market for African night shade seed and products • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in African night shade production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • African night shade is considered women's crop. and requires low external resources for production. Most labour for African night shade production is provided

	by women; therefore, increased production is likely to provide employment to women. • With commercialization of African night shade as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing African night shade productivity for food and nutrition security and income generation. In particular, production of African night shade is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the African night shade. Youth could also benefit through application of ICT networking for marketing of African night shade. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter African night shades commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the African night shade.

	• The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. Under the two projects farmers in Nandi and Kakamega counties produced seed of AIVs species (Amaranth, spider plant, nightshade, cowpea, slender leaf, jute mallow) in both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels • National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems. Farmer groups in Vihiga county formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and send to Nairobi
Application guidelines for users	• Leaflets on African night shade seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

5.3 Agronomic management practices (African nightshade)

TIMPS name	**Variety selection, Seed acquisition or Own Seed Selection, Planting, Weeding, Thinning, Fertilizer Application, Pest and Disease Management, Harvesting, Storage and.**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Low farm yields

	• Poor management and agronomic practices at farm level
What is it? (TIMP description)	-This includes:- **seed acquisition:** - Certified seed or training on proper own selection **Land preparation** • Plough deeply and harrow to obtain fine seedbed Raising Seedlings • Use of clean seed is recommended due to high incidences of seed borne diseases • Seed Rate: 50 g per acre **Nursery Site Selection:** • The nursery should be located in a plot that has not been planted with crops in the Solanaceae family for at least three (3) years Note: • Trays can also be used for raising seedlings Nursery Establishment: • Involves site preparation, construction of nursery infrastructure and basic nursery tools • Nursery soil should be loosened and enriched with well decomposed manure • Make drills at a spacing of 10 – 20 cm apart; thinly sow the seeds in the drills and cover lightly with soil • Management of Nursery: • Adequate watering is essential for proper growth • Water the nursery regularly • The nursery should be mulched to conserve moisture Weeding: • Keep the crop weed free until it is well established • There after keep the field weed free • Thinning: • Subsequent thinning should be done until the onset of heading, leaving one plant at an intra-row spacing of 30 t0 40 cm apart depending on varieties • Harvesting: • Maturity Period: 60 days after direct seed sowing in the field or 30 days after transplanting • Harvesting Method: – The most common way of harvesting is regular plucking of leaves (multiple harvesting), twice per week – 14 days after transplanting, cut the growing point of the plant to encourage branching; and 2 weeks later start plucking the young shoots and continue harvesting every 1 to 2 weeks for 3 to 4 months • Harvest the fruit when it turns into a black/purple colour if the crop is for seed production

	• Another method is once-over harvesting where the whole plant is removed by uprooting • This is done either as thinning or if there is close spacing • Plucking method determines the longevity of harvesting • Regular removal of flowers ensures longer harvesting period • Yields: • Range from 4.8 tons to 8 tons of foliage per acre depending on the variety and management
Gender issues and concerns in development, dissemination , Gender adoption and scaling up	• Spider plant stakeholder might not have adequate knowledge of the existing good agronomic practice especially women since they have less access to agricultural information and extension services • Women and youth have the perception that good agronomic practices are oppressive, time consuming and labour intensive as they do not see the working for their good • Most small-scale production systems are centered women and hence it's them who suffer from the detriments of poor processes; for example, improper site selection , preparation sowing, thinning and harvesting • Women farmers have no finances to pay hired labour so as to ensure that good agronomic practices are embraced due to limited access to credit facilities • Women are the ones who are usually engaged in spider plant production and they are usually left out when important agricultural workshops are held due to the social status in the community
Gender related opportunities	Increased productivity will benefit the household Adopting agronomic practices will lead to increased production of the spider plant hence there will be creation of employment for women and youth Adopting appropriate agronomic practices will lead to improved food security and nutrition for house holds Adopting appropriate agronomic practices will lead to increased income for women and youth
VMG issues and concerns in development, Dissemination, adoption and scaling up	• Some of the agronomic practices are complicated for VMGs to undertake such as land preparation especially for those who are abled differently • VMGs have no finances due to limited credits to hire labour and also to purchase required facilities required while applying appropriate agronomic practices • VMGs might not be able to get information relating to appropriate agronomic practices due to limited access to agricultural information and extension services

	• Due to their social status VMGs are often excluded from participating in workshops and in dissemination meetings relating to where appropriate agronomic practices are discussed • Most of the VMGs might not get adequate information relating to the agronomic practices due to unfriendly dissemination methods and low illiteracy of the VMGS
VMG related opportunities	• Increased income due to improved production as a result of using appropriate agronomic practices by VMGs • There is potential of stable income and livelihoods for the VMGs • Application of appropriate agronomic practices will lead to improved food security and nutrition for VMGs

5.4 Soil Fertility Management TIMPs for African Night Shade

Rapid Soil Testing Services

TIMP name	**Rapid Soil Testing Services**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are expensive for farmers, results take long and are not reproducible. Further, conventional methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing using the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It does not require the routine laboratory analysis using chemicals. When a sample is run though a scanner, soil testing results are generated with accompanying recommendations instantly. However, the method requires partners involved (ICRAF, iSDA and SoilCares) to work closely with KALRO and county agricultural officers to sensitize farmers to embrace the testing method.

	This innovation will involve working closely with agronomists to generate specific fertilizer recommendation driven by soil and crop data obtained.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches used in dissemination	Farmer visits Training in workshops Publicity campaigns done at County levels
Critical/essential factors for successful promotion	• Availability of the necessary equipment (Scanner and accessories) for rapid on-site soil testing. • Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. • A well-designed information storage system for data obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data, fertilizer recommendation according to crop type suitability). • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	• County government extension services; Providing the link to farmers. • Soilcares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and iSDA; Tests and validate the recommendations obtained in collaboration with SoilCares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	

Counties where already promoted if any	Technology has not been promoted though testing has been ongoing in a few counties
Current Counties where already promoted if any	Minimal reach in Nyeri County
Counties where TIMP will be promoted	All 24 KSAP Counties
Challenges in dissemination	• It requires continuous updating of methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated methods for updating existing recommendations by generating local soil libraries.
Lessons learned if any	Timely affordable soil information will guide on fertilizer use. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Copper.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly; -Recommendations provided ensures that farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Market will absorb the increased productivity • Supporting frameworks/policies are available. • Training of personnel at national and County levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Soil testing equipment and License, sampling and packaging materials (Kes 650,000/=), personnel and logistics (will depend on site/location). • Shipping selected soil and plant materials for further testing and results verification in a certified lab. • There are other additional costs on professional consultation.
Estimated returns	At least 30% profit for soil testing business venture using the scanner. Farmers end up getting higher returns on the crops grown and amounts depend on specific value chain. High value crops will give higher returns compared with subsistence crops.

Gender issues and concerns in development, dissemination, adoption and scaling up	• By bringing services closer to the users saves farmers (men, women and youth) time and resources.
Gender related opportunities	• Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. • The scanner equipment is light and women and youth can easily transport and operate it.
VMG issues and concerns in development, dissemination, adoption and scaling up	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and is also expected to improve productivity
E: Case studies/profiles of success stories	
Success stories	Has been tested used successfully by other organizations like ICRAF, SoilCares & former Kenya Sugar Research Foundation. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugar cane
Application guidelines for users	• A handheld scanner to test soils and crops in the field • Community soil sampling champions are identified and trained on good soil sampling procedures. • Soil and crop is analysed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO; C. Kibunja, E. Gikonyo, Christy van Beek, A. Sila, D. Kamau, A. Esilaba and S. Kimani
Partner organizations	County governments in the 24 counties, SoilCares, ICRAF and iSDA

Research gaps

1. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
2. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller

quantities as per farmer needs.

5. Using scanners at farm level to undertake fertilizer quality analysis, e.g. quantitative and qualitative analysis, major and trace elemental analysis, and chemical and physical analysis.
6. Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country

Integrated Soil Fertility Management (ISFM)

1.1. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil fertility, low organic matter, poor soil structure and limited available moisture in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed and good agronomic practices to adapt to local conditions. ISFM places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence
Justification	Soils within the farming system are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. The aim of ISFM is therefore to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Training in workshops On-farm visits Farmer field schools (FFS) On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; • Availability of clean/certified seed • Availability of novel crop protection practices, and • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in
Partners/stakeholders for scaling up and their roles	• County government extension services - Provide linkage with farmers. • Community farmer groups - play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Current Counties where already promoted if any	Practised in some value chains in the 10 Counties above
Counties where TIMP will be promoted	Bomet, Kericho, West Pokot, Taita Taveta, Lamu, Nyandarua, Tana River, Baringo, Marsabit, Garissa, Kajiado, Laikipia
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Lack of guidelines on how to combine manures/organic materials with modest amounts of mineral fertilizers. • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, etc is required since farmers tend to re-use previous planted materials. Knowledge of how to combine organic and inorganic fertilizers is required.

Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Increased productivity will provide supply to the markets, • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically demanding technology and high cost are incurred in acquisition of inputs.
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice integrates participation of male and female gender roles during field activities. Female gender is disadvantaged where application of heavy loads of manure is to be incorporated in the field. Adoption and scaling up of ISFM technologies could be affected by: Ownership of the farm, that are mainly male owned but the implementer of the ISFM in most cases is female Quality inputs and their availability in time
Gender related opportunities	Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that save on cost which benefits all gender in the farm household.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs are physically disadvantaged for a practice that seeks to incorporate manures, and chemical sprays in the farm. They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice
VMG related opportunities	The technology if well practised can increase farm incomes of VMGs by up to 50%.
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in maize in central and western Kenya highlands. Successes have also been reported for sorghum and millet value chains in Machakos where the productivities have been improved
Application guidelines for users	• Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. • Ensure that good agronomic practices are upheld • For sustainability, use of pure inorganic or organic materials should be avoided but should be used in recommended combinations. • Adapt the practice to local conditions
F: Status of TIMP readiness	2 =Requires validation

(1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	
G: Contacts	
Contacts	Centre Director, KALRO Kabete P. O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; E. Gikonyo, C. Kibunja, A. Muriuki, D. Kamau, A. Esilaba, J. Ndufa and S. Kimani
Partner organizations	County governments, NGOs, CIGs, KEFRI

Research Gaps

1. Validation of the ISFM technology in Counties where technology has not been tested.
2. Testing (fertilizer types, rates, frequencies) and combination with manures for different value chains

Integrated Manure Management (IMM)

1.2. TIMP name	**Integrated Manure Management (IMM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)  *Source: J. Oyoo, Tigoni*	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops. Manure is obtained from different animals (poultry, cow, goat, horse) on the farm, but it can also be bought from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties all of which are important for soil quality and crop production.
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are depleted at annual rate of 22kg/ha

	for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health. The efficient use of manure is enhancing the capacity of the soil to conserve and accumulate soil organic carbon; maintain or improve crop yield by supplying nutrients when required by plants and reduce effects of climate change through sequestration of carbon.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Public and private practitioners
Approaches used in dissemination	On-farm and on-station demonstrations Open and Field days Agricultural shows MoA/Extension officers Partners Farmer to farmer peer learning Mass media- e.g Mkulima programme, Smart Farmer and Seeds of Gold Workshops, Seminars, Meetings, trainings Promotional materials (posters/brochures/leaflets) Social Media platforms Exchange visits
Critical/essential factors for successful promotion	• Training on feeding, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using several crops
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I)-National and County level -extension services and link with farmers CIGs (Common Interest Groups)- co-ordination roles and back stopping at grass root levels ILRI- technical backstopping NGOs (Non-governmental organizations)-promotion, micro financing etc.
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Uasin Gishu

Current Counties where already promoted if any	Though small scale farmers in the counties apply manures and composts on their farms, they do not optimize on usage.
Counties where TIMP will be promoted	Bomet, Kericho, Laikipia, West Pokot, Taita Taveta, Nyandarua, Lamu, Tana river, Baringo, Marsabit, Garissa, Siaya, Kisumu
Challenges in dissemination	• Limited model demonstration farms • Cultural challenges -Lack of interest by pastoral communities • Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	• Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure preparation, storage and application
Social, environmental, policy and market conditions necessary	• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbour pathogens which can cause disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time. Manure costs are dependent on types e.g. goat, sheep, poultry Using locally available manure/composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practised

Gender issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application (often by broadcasting) hence may disadvantage women and youth
Gender related opportunities	Manure is locally available for farm households who keep livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application hence may disadvantage VMGs. The VMGs are also resource poor, hence may not have access adequate manures, e.g. need large livestock herds
VMG related opportunities	Manure is locally available for those farm households with livestock and can build on what they already own
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income e.g. keeping one steer in a smallholder farm measuring 0.45ha in central Kenya produces manure equivalent to 112kgN/ha/year of whole farm area when optimum collection and manure composting strategies are followed.
Application guidelines for users	The guideline focus on the following areas:- • Animal feeds • Livestock housing and manure collection • Manure storage to preserve nutrient and avoid loses • Manure treatment for ease of transport and application in the field • Timing of application for maximum utilization by the crop • Anaerobic digestion for biogas production • Regular analysis of manure to ascertain the quality • Manure/Composts take a long time to cure, hence need good planning prior to use • IMM is always site specific and users advised to only use information relevant to local circumstances
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO

	S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations	County government, Private Public Partnerships, CIGs

Soil and Water Management TIMPs African Night Shade
Rain water harvesting through Roof water catchment

2.6. TIMP name	**Rain water Roof water catchment**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)  *Source: C. Kundu,*	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface run off). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. Examples of rainwater harvesting are rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage By collecting, storing and utilizing water agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high- value crops, and extending their growing season through the entire year. Technology also slows water run off and increases yields with the additional water
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralists
Approaches used in dissemination	Demonstrations on technology use; Farmer Field Schools; Technical training and re-tooling of extension personnel; Awareness creation through various platforms like local FM stations
Critical/essential factors for successful promotion	• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems • Policy to support use of communal land to establish and

	manage the earth dams • Policies supporting Public-Private Partnerships in water harvesting • Sensitization of local communities to embrace the practice
Partners/stakeholders for scaling up and their roles	• Private sector – access to technology, access to credit, technology installation • County government – capacity building, policy support, credit facilities, • NGOs – access to technologies, capacity building, technology installation
C: Current situation and future scaling up	
Counties where already promoted if any	Most counties are investing on water harvesting technology at community level. More is required to increase uptake at household level
Current Counties where already promoted if any	Practised widely in most counties
Counties where TIMP will be promoted	ASAL counties; Tana River, Marsabit, West pokot and Mandera
Challenges in dissemination	• High costs related to technology access and management • Resource use conflicts where land is communally owned • Limited skills in technology installation and management • Limited community mobilisation policy for water related activities • Lack of suitable training programmes in rainwater harvesting • Lack of proper water usage and control measures • In the case of earth dams where there is a lot of siltation, regular de-siltation is required. • Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance. • Vandalism • Some systems require high investment costs
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training programs water harvesting technologies, maintenance and operation skills • Cost of buying water harvesting structures is very high for most households and needs to be reviewed.

	• Securing systems to prevent vandalism
Lessons learned if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented
Social, environmental, policy and market conditions necessary	• Devise systems that are gender sensitive – target different gender needs • Carry out environment and social impact assessment of the technology in specific Counties and cultures • Support structures that help access to credit for technology access and maintenance • Enact Policy frameworks to support water harvesting • Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost dependent on the type of materials to use for harvesting and storage. Not readily affordable to most rural households
Estimated returns	• Time saved fetching water from afar is channelled into other economic enhancing activities. • Money used to treat diseases related to poor water hygiene is used for other activities. • Healthy population will have energy to provide labour required in agricultural activities
Gender issues and concerns in development, dissemination, adoption and scaling up	• The distance from household need to be considered as women are the custodian of households in terms of domestic water demands. • The design of the water pans should take care of the Occupation, Health and Safety of the communities • The technologies will reduce time needed to fetch for water which will impact positively the women
Gender related opportunities	Water harvesting facilities save the time spent to collect water from far off, usually by women. The saved time is channelled into other economic activities
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to credit or financial services may limit access to technology • The land tenure systems may inhibit adoption of technology
VMG related opportunities	• Develop SME opportunities around water harvesting. Also do small food gardens and tree nurseries around water pans • VMG maximize can engage in n availability of water to engage in small IGAs around water harvesting • Livestock too easily access water and their market value likely to appreciate • The technology will reduce the time used to search for water

E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres. This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	Agro-pastoralists and farmers in target counties need training and empowerment on the technology and attendant management practices. **References** Handbook on Rainwater Harvesting and Storage Options Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling
G: Contacts	
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Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPPs

Research gaps

1. Development of models of rain water harvesting for intensive agricultural production and household use

Mulching

2.3. TIMP name	Mulching
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in the soil, weed infestation, loss of organic matter, managing salinity in ASALS and low crop yields.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials such as straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production. Plastics like polythene, and row covers are also used as mulch. Benefits: retain moisture in the soil; suppress weeds; lowers soil temperature; and help improve soil fertility (as the mulches decompose).
Justification	Mulching facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It minimizes weed problems and nutrient loss. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	• Farmer field schools • On-farm demonstrations during farmer field schools • Training in workshops
Critical/essential factors for successful promotion	• Availability of plant or crop residues. • Size of the land. • Competing uses of crop residues. • Type of the crops
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers • Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Current Counties where already promoted if any	Available and practised in different commodity value chains
Counties where TIMP will be promoted	All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses • Possibilities of insect build up categorized as pest or disease vectors

Suggestions for addressing the challenges	• Crop diversification to increase availability of residues. • Establish and follow a good integrated pest control management program for the particular crop. • Adapting alternative mulching materials like high absorbance polymers in fruit trees like mangoes and Bananas, as well as plastic mulches and row covers in vegetables
Lessons learned if any	There is need to adapt alternative mulching technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive practice during the initial application. Such costs are dependent on value chain and plant spacing. However, plastic mulch is costly and needs to be used for high value crops.
Estimated returns	Dependent on the type of value chain and mulch used
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict for those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere. Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is be a bit labour intensive for VMGs, hence its adoption and scaling up
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	Judith Henze, Mary Abukutsa-Onyango, and Arnold Opiyo, 2020. Production and Marketing of African Indigenous Leafy Vegetables. Training Manual for Extension Offcers and Practitioners

F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling (Organic mulch) 2 and 3= Requires validation and further research(plastic mulch)
G: Contacts	
Contacts	Centre Director KALRO Kabete. P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, D. Kamau and S. Kimani
Partner organizations	County governments Public-Private-Partnerships

Research gaps

1. Research on mulching using plastics, factory/industrial wastes, e.g. mushroom, tea, coffee, etc. in different value chains is required

5.5 Irrigation and Drainage Management African Night Shade

Solar irrigation systems for smallholder farmers

TIMP name	**Solar Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High cost of pumping water for irrigation, using electricity or fossil fuel powered pumps; reduction of greenhouse gas emissions
What is it? (TIMP description)	This is a technology that uses solar power in the pumping of irrigation water and running of the irrigation systems
Justification	There has been general increase in prices of diesel and electricity making pumping of irrigation water to be a costly operation. Though Solar panels have been used successfully to light houses and in small businesses in the rural areas, they have hardly been used in the irrigation systems despite their potential. Solar power would be a good source of power for addressing climate smart agriculture focusing on renewable and green energy. It also has the advantage of low cost and sustainability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	On-farm and on-station demonstrations Field days

	Training in workshops Stakeholders forums Technical releases
Critical/essential factors for successful promotion	• Documentation of available solar irrigation systems • Access to solar irrigation performance data. • Improving solar irrigation systems efficiencies in irrigation schemes • Creating local support for solar irrigation technologies
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Various Counties including Marsabit, Garissa, Machakos, Nyeri, Kajiado, Siaya, Bomet, Kericho and Uasin Gishu
Current Counties where already promoted if any	Practised in individual farms as well as in few group farms for high value crops like tomatoes
Counties where TIMP will be promoted	All the 24 KCSAP Counties
Challenges in dissemination	• Farmers lack knowledge on the potential of solar as a power source for irrigation systems • High cost innovation
Suggestions for addressing the challenges	• Awareness trainings on different solar irrigation systems • Awareness creation on advantages of solar irrigation systems pumps to governments, farmers and development agencies. • Capacity building of extension workers • Developing information packages • Creating solar irrigation systems network
Lessons learned if any	• Solar irrigation systems should be well designed in water delivery, storage and application to the field.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Policies are friendly to the technology • Capable of increasing marketable products
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Higher investment costs but low operation costs. Costs depend on the energy required and size of irrigated area.
Estimated returns	• Not yet done
Gender issues and concerns in development, dissemination, adoption and scaling up	Solar irrigation is friendly to female gender compared to diesel or electric systems because they have low running and maintenance costs. It is modern technology that is attractive to the youth
Gender related opportunities	The systems are adaptable to different irrigation scenarios thus fitting to all genders.

VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs may not afford the investment costs but will afford the operational and maintenance costs if assisted
VMG related opportunities	The technology can increase farm incomes of VMGs by more than 70% because of the very operation and low maintenance costs
E: Case studies/profiles of success stories	
Success stories	Solar irrigation systems success stories have been reported in Counties such as Kajiado on high value crops
Application guidelines for users	Choose a solar irrigation system that suits the farm area to irrigate Use efficient water application method such as drip to avoid wastage since the water is relatively scarce.
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; I. V. Sijali, M. P. O. Radiro, F. Karanja, F. Kaburu
Partner organizations	Solar irrigation systems suppliers County governments National Irrigation Acceleration Programme (NIAP)

Research Gaps

1. Validation of the solar irrigation systems in the different counties.
2. Up scaling of the technology to smallholder community schemes
3. Solar irrigation systems that maximize crop water productivity

Drip Irrigation Systems

3.2. TIMP name	**Drip Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Increased crop water stress caused by seasonal rainfall variability in rain fed production
What is it? (TIMP description)	This is a technology that supplies water to plants grown in solid substrates in small controlled drops. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points

 Layout of a drip irrigation system in vegetables	(drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water
Justification	The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Main streaming drip irrigation systems into crop production provides the opportunity for farmers to enhance crop resilience, increase yields and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Model Farmers
Approaches used in dissemination	Field Demonstrations, farmer field schools, ASK trade and exhibition fairs
Critical/essential factors for successful promotion	• Correct field design (system installation) of the drip system to minimize water inefficiencies. Training of farmers and extension • Drip management skills
Partners/stakeholders for scaling up and their roles	• County governments; capacity building, supportive policies and frameworks • Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Bomet, Kajiado, Machakos
Current Counties where already promoted if any	Limited to high value tomato and vegetable farmers in the above counties
Counties where TIMP will be promoted	High value crop production (e.g. tomatoes, vegetables, bananas) in Elgeyo Marakwet, Bomet, Kericho, Kajiado, Mandera, Siaya, Tharaka Nithi, Nyandarua, Nyeri, Kisumu, Busia, Taita Taveta, Machakos, Isiolo, Laikipia, Marsabit, Baringo and Garissa counties

Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Suggestions for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned if any	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil • It is also important to link farmers to Micro Finance Institutions for financial needs
Social, environmental, policy and market conditions necessary	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems • The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES 100,000
Estimated returns	• Income from drip system rises by as much as 35% stemming from the management of crop water stresses. • Increased water saving means more water is available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Drip systems are easily installed and therefore suitable for both male and female gender • Drip system tends to reduce workload for all gender and provides significant positive impact on family food and nutritional intake. • Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours • Acceptable and easy to scale up by both male and female, including youth

Gender related opportunities	Opportunities available for women and men to generate sustainable income
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMG
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables
E: Case studies/profiles of success stories	
Success stories	There are many successful farmer drip irrigation models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability
Application guidelines for users	● Use appropriate emitters during design and installation i.e. sites with elevation difference of over 1.5 meters (5 feet), use pressure compensating emitters and turbulent flow emitters more level areas. Gravity flow systems normally use short-path emitters ● Use 1 or 2 emitters per plant depending on the size of the plant. Trees and large shrubs may need more. ● In most situations install emitters at least 450mm (18″) apart. 600mm (24″) apart under 80% of the leaf canopy of the plant ● Always have a backflow preventer to prevent water contamination by soil-borne disease. Use a 20mm (3/4″) valve for most systems ● Use 25mm (1 inch) PVC, PEX or polyethylene irrigation pipe for mainlines (“mains”) and laterals ● The total length of the mainline and the lateral together should not be more than 120 meters (400 feet). ● The length of drip tube should not exceed 60 meters from the point the water enters the tube to the end of the tube ● Never bury emitters underground unless they are made to be buried ● Don’t bury drip tube, moles or other rodents will chew it ● Always install a flush valve or end cap at the end of each drip tube. Automatic flush valves are also available **References** 1. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA’s Regional Land Management Unit, Nairobi. 2. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/a-i3765e.pdf
F: Status of TIMP readiness (1=Ready for up scaling:	1 =Ready for up scaling

2=Requires validation; 3=Requires further research)	
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Isaya Sijali,
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

Research gaps

1. The impact of drip irrigation on economics of agriculture in the regions of adoption under study
2. Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption

5.6 African Indigenous Vegetables Diseases

Integrated Management of African Nightshade Diseases

TIMP name	**Integrated Management of Early blight disease in African Nightshade**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to infection of African nightshade by the disease
What is it? (TIMP description)	Integrated management of comprises the use of cultural management practices and chemical control in itsmanagement. **Cultural practices:** • Crop rotation with non-legumes for a period of 2 to 3 seasons • Rogueing out infected plants from the farm and burying then deeply. • Avoidance of working in the fields when plants are wet to minimize spread. • Disinfecting farm tools in jik solution (50 ml: litre). • Practicing good field sanitation and hygiene practices by collecting and disposing infected plants. **Chemical management:** • To suppress the disease, spray copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50gm/20litres water or Isacop 50WP at a rate of 60g/20litres of water)

	• Get other control products from the PCPB (www.pcpb.or.ke)list of registered pest control products, and use them accordingto the manufacturer's instructions.
Justification	Early blight disease is a major disease challenge occurring in all major production areas, but being more severe in some regions. It causes significant yield loss because it causes death of tissues, hence limiting the ability of the plant to photosynthesize. Integrated Disease Management is an environmental friendly approach that enables the control of the disease and cultural practices that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	

Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	• More than one approach is used in management of major diseases • IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities inthe evaluation of the technology enhances technologyadoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	• Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to agro-vets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge • Women might have limited knowledge on integrated management of African Nightshade in bacterial leaf blight.

Gender related opportunities	• Opportunities for youth employment in implementing IDM protocols • Opportunities in marketing pesticides
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access agro-vets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**Reference:** CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO-Kabete, Ruth Amata., Daniel Mutisya., Nzioki C., Rael Karimi and Harun Odhiambo
Partner organizations	Extension service providers, CGIAR, CABI, ICRAF

Research Gaps:

1. Explore Bio-control option for insect vector
2. Explore the use of ITKs in disease management

Integrated Management of African Nightshade Pests

TIMP name	**Integrated Management of Root Knot nematodes in African Nightshade**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	Yield losses of up to 25.6% due to root knot nematodes
What is it? (TIMP description)	Root knot nematodes affecting African Nightshades are controlled through cultural management practises and chemical control; **Cultural practices** • Crop rotation with non-leguminous crops i.e. crops in the grass family for 4-6 seasons. • Avoidance of surface run off as it spreads the pest to non-infected areas, uprooting affected plants and burying. • Soil solarization during dry months of the year on severely affected fields. • Cleaning of farm tools and equipment's after use • Incorporate Tithonia or Mexican marigold as green manure into the infested soil during planting **Biological control** • Drench infested soil with neem based products e.g. Nimbecidine at a rate of 60ml/20L **Chemical management** • Drench with *Trichoderma* spp based biopesticides in the rooting media.e.g.Trianum P at a rate of 45g/15L of water
Justification	Nematodes cause considerable reduction in yield and lower the grain quality of African Nightshades. Where the nematode is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks

	• Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages with African Nightshade stakeholders • Undertake applied and adaptive research to validate and release improved African Nightshade varieties • Create a platform for interaction of African Nightshade value chain stakeholders • Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continue undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • Farmers/Farmer Groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be upscaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides

	• Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPE)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) • Spraying of the crop will create employment opportunities for young male youths
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as credit and pest control products • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

	• VMGs have limited access to pest management information • There is low adoption by VMGs due lack of awareness • VMG may have a challenge in utilization of spraying equipment
VMG related opportunities	• Opportunities for unemployed rehabilitated male youths exist in pest scouting and cotton spraying programmes
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata., Miriam Otipa., Harun Odhiambo, Mercyline Orayo and Christine Ndinya
Partner organizations	Extension service providers, CGIAR's, NGOs, County governments, Help in the dissemination of the technology,

Research Gaps:

1. Explore the use of ITKs in pest management
2. Explore the use of Trichoderma based products for biological control of nematodes

2.6.2.2 TIMP name	**Integrated Management of Black aphids**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids infestation causes up to 70% yield loss on African Nightshade
What is it? (TIMP description)	This is an integrated approach of various control methods suppress the aphids below economic injury levels. **Cultural Control** • Prepare land well and apply 10 kg CAN/acre and 14 kgs/acre DAP to increase plant vigour • Control ants by ploughing and flooding the field to destroy

	the colonies, expose eggs and larvae to predators • Conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grass hoppers and spiders) by planting lantana hedges to act as breeding grounds for predators • Rotate with non-host crops e.g. maize, upland rice, sorghum, okra, sugarcane, and sunflower to prevent build-up of population. Avoid alternate host crops such as beans, lucerne, pigeon pea • Remove heavily infested plant parts and destroy by burning • Apply neem based products (e.g. neem oil 40ml/20lts of water, Achook) 2 times/month • Spray with soapy water solution (mix 1 tablespoon of teepol detergent with 4 lts of water or use strong jet of water to wash off aphids **Chemical Control** Use only pest control products recommended by Pest Control Products Board (PCPB) such as: • Use Danadim Blue 40 EC (Dimethoate 400 g/L) • Duduthrin 1.75 EC *(Lambdacyhalothrin 17.5 g/L)* • Spray using Atom or Decis at the rate of 10-15mls/20lts of water
Justification	Aphid causes direct damage by sucking sap from plant tissues, leading to deformation, reduced plant height with few flowers and shrivelled pods. Aphids cause considerable reduction in yield and lower the grain quality of African Nightshades. Losses of above 20-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that African Nightshade is consumed widely. The combination of cultural and bio-control and biopesticides is relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers

	• Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in pest management • PCPB to promote registration of bio-insecticides for integrated pest management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM

	• Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets than men • Women have less access to agricultural information, technology and knowledge such as integrated management of African Nightshade aphids • Men dominant most decisions at the household and community levels
Gender related opportunities	Opportunities for youths exists in spraying the crop
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets where they could access pesticides as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques

VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E. Case studies/ profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	1-ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO: Otipa M., R. Amata, Odhiambo H. Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on aphids identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of Aphid
- Determine the effects of aphid on the yield, quality and implication on economic returns for the farmer

2.6.2.3 TIMP name	**Integrated Management of Flea beetle**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Flea beetle causes windowing on flower and leaf tissue with up to 40% yield loss
What is it? (TIMP description)	Integrated management of the beetle includes the use of various pest control strategies. The strategies include cultural, biological and chemical control. In order to realize an effective management program for this insect, one has to start chronologically from preventive to curative pest control measures i.e. from cultural to chemical control. It

	begins with the most environmentally friendly (cultural) strategy as you move towards harsh (chemical) pest control methods. This management practice starts with pest scouting/ monitoring, pest identification and establishment of economic threshold and finally a decision is made on which of the following pest control measures to use **Cultural control** • Preventive control measures are sanitation by removal of plants and all debris as soon as harvesting is over. • Hand pick and destroy the beetles at the beginning of infestation as this will help to reduce the population density • Remove alternative host near the crop **Biological control** • Use natural enemies such as domestic chicken and allow perching birds to prey on beetles • Use biopesticides such as Nimbecidine EC (*Azadirachtin 0.03%).* **Chemical control** **Use** only pest control products recommended by Pest Control Products Board (PCPB) such as: • Bulldock star EC 262.5 *(Beta-cyfluthrin 12.5 g/L +Chlorpyrifos 250 g/L)* • Tata-alpha 10 EC (*Alpha-cypermethrin (10 g/L*) • Decis 2.5 EC *(Deltamethrin25g/L)* • Duduthrin 1.75 EC *(Lambdacyhalothrin 17.5 g/L)* Synthetic pesticides should be used as the last option since most of them are detrimental to the environment
Justification	These yellow stripped beetles destroy flowers and buds causing flower defoliation. The beetles cause considerable reduction in yield and lower the grain quality of African Nightshades. Where the beetle is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmer

Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Farmers adopt appropriate agronomic practices Have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Farmers are reluctant to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides

	• Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge • Due to their social status women and youth are often excluded from decision making in pest management
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production of cotton leading to stable supply of cotton to the market
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to information on production techniques • VMGs have limited access to information such as in integrated management of blister battles • There is low adoption by VMGs due lack of awareness

VMG related opportunities	• Employment for youths and those recovering from drugs exists in spraying the crop • Improved production for VMGs
E. Case studies/ profiles of success stories	
Success stories	This is the first time the information is being rolled out.
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	1-Ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO M Otipa., R. Amata., Odhiambo H., Orayo M and Ndinya C.
Partner organizations	International research agencies; ICIPE, ICRISAT, Real IPM, Dudutech

Research Gaps

- Capacity building on Yellow stripped blister beetle identification and management
- Validation of biopesticides and synthetic pesticides in the management of Yellow stripped blister beetle
- Determine the effects of Yellow stripped blister beetle on the yield, quality and implication on economic returns for the farmer

2.6.2.4 TIMP name	**Integrated Management of Desert locust (*Schistocerca gregaria*)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	90% yield loss occasioned by feeding on foliage which occur in swarm of 5-20 million hoppers.
What is it? (TIMP description)	Integrated management of desert locust is a regional program involving multi-sectoral efforts as follows;

	• A global early warning system of preventive and control of DL is in place. Kenya is a member of Desert Locust Control Organization of Eastern and Central Africa (DLCO-EA). • DLCO-EA uses remote sensing technology and ground surveys to identify and control desert locusts (DL) in their breeding sites. It uses satelite imagery for the identification of potential breeding sites and locust infestations. • Prevention requires a collective effort across regions. • Scouting and control of DL in recession (traditional breeding) regions will prevent infestation in invation (non-traditional) regions • Scouting should be synchronized with early warning systems reports from FAO • Spray hopper bands using Metarhizium anisopliae based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real metarhizium OD (rate 200ml/ ha) among others. Spray at intervals of 3 - 14 days depending on risk of pest damage • Spray with Chlorpyrifos ULV based products like Mursban 480 EC (rate 75ml/20lts water), Agropyrifos 48 EC (20ml/20lts water), Regulator 450 EC (20mls/20lts water), Gradomete R 480 EC. (rate is 1 ltr/ha) • Spray with Fenitrohion based products like Delta 1.01% Dust, Sumicombi 1.8% Dust, Sumithion super. (rate of 1ltr/ha)
Justification	Desert locust cause devastating total vegetative loss of many crops which calls for urgent action by the Ministry of Agriculture and all stakeholders in the region to prevent crop loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers, Extension agents
Approaches to be used in dissemination	• Agricultural shows • MoA/Extension officers • Farmer research networks • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	Need for farmer involvement helps in test evaluation and up scaling of what they learn in the process.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies

	• County governments, central governments for development of enabling policies and create awareness • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM. • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development,	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men

dissemination adoption and up scaling	• Women and youth have limited finances to purchase pesticides • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge for instance they might not have knowledge of integrated management of Migratory locust
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to improved livelihoods
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop • Increased production leading to improved livelihoods of VMGs
E. Case studies/ profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	1-ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075

Lead Organization and Scientist(s)	KALRO-Katumani: M Otipa., R. Amata, Odhiambo H. and Ndinya C.
Partner organizations	Universities, ICIPE, ICRISAT, FAO, Dudutech, Real IPM

Research Gaps

- Capacity building on management of desert locusts
- Validation of biopesticides and synthetic pesticides in the management of desert locusts

2.6.2.5 TIMP name	**Integrated management of Cut worms on African Nightshade**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cutworms cause up to 100% damage on African Nightshade seedlings
What is it? (TIMP description)	Integrated cutworm management consist of various approaches to prevent grain damage. **Cultural practises** • Ploughing exposes caterpillars to predators and to desiccation by the sun. • Prepare field and vegetation and weeds destroyed 14 days before planting • Delaying transplanting slightly until the stems are too wide for the cutworm to encircle and/or too hard for it to cut may reduce cutworm damage. • Hand picking of caterpillars at night by torch or very early morning before they return into the soil is useful at the beginning of the infestation. • Flooding of the field for a few days before sowing or transplanting **Biological management** • Use repellent neem extract 3 times at weekly intervals • Use of ash on the seedbed • Use of molasses at the base of each plant
Justification	Cut worms cause considerable reduction in yield and lower the grain quality of African Nightshades. Where the cut worm is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-100% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse

	of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer • Accessibility of the TIMP by the farmers
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides

	• Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women farmers might not be aware of the Integrated management of cutworms • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to credit facilities for them to purchase inputs • Women and youth have limited access to education, training and extension services than men • Women dominate in the production of African Nightshade therefore there is need to ensure gender balance during trainings • The application of chemical to spray is usually associated with men
Gender related opportunities	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of African Nightshade cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

	• VMGs have limited access to seed and information on new varieties and production techniques
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R. Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on Cut worm identification and management
- Validation of biopesticides and synthetic pesticides in the management of cut worm
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer

2.6.2.6 TIMP name	**Integrated management of red spider mites on African Nightshade**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Red spider mites cause up to 100% damage on African Nightshade grain when in storage.
What is it? (TIMP description)	Integrated management of spider mites consists of several approaches applied in an integrated manner to break the cycle of the insect. These include: **Cultural Control** • Keep the farm weed free from the alternative hosts such as solanum family crops that may habour red spider mites • Avoid planting tomato next to infested field or crops. • When moving through the farm, start with the healthy area before moving to infected section. • Conserve natural enemies or release purchased predatory *Phytoseilus* species from Real IPM or Dudutech Ltd. • Use overhead irrigation as it helps in drowning the mites hence reducing their population • Spray with neem extracts (500 grams of leaves in 5 litres of water) • Prun overcrowded plants and destroy the crop debris by burning. **Bio-control control** • Spray with neembicidine based products such as Achook • Release predatory mites (*Phytotech* and *Amblytech* from dudutech) *Phytoseiulus persimilis* species and *Amblyseius cucumeris* • Conserve natural enemies in the environment or release purchased predatory *Phytoseilus* species from Real IPM or Dudutech Ltd **Chemical Control** • Spray with abamectin 18g/kg based synthetic pesticides (Dynamec 20EC 5ml/20litres water, Knockbect 40EC, 10 ml/20 Litre water) or • Spray with Amitraz 200g/L based miticides (Kilitac 20EC, Mitac 20 EC. Rate 10ml/20Litre water)
Justification	Red spider mites cause considerable reduction in yield and lower the grain quality of African Nightshades. Where the spider mites

	infestation is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and bio-pesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required. • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer. • Accessibility of the TIMP by the farmers.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in pest management • PCPB to promote registration of insecticide for pest management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	-Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for African Nightshade production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies

	• In adequate knowledge on IPM strategies on insect pests infesting African Nightshade and losses attributed to them • Poor linkages among stakeholders in African Nightshade value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish African Nightshade innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge • Due to their social status women and youth are often excluded from decision making in pest management
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production of cotton leading to stable supply of cotton to the market

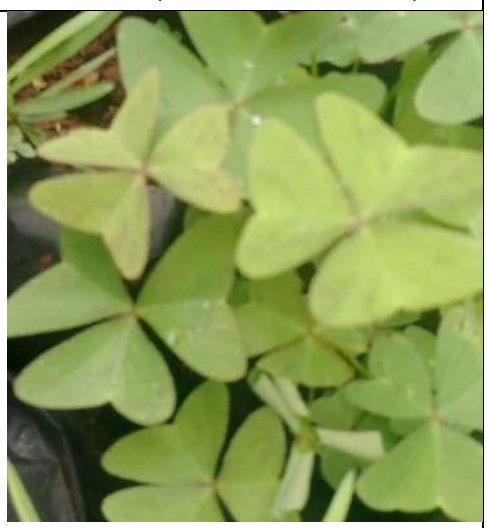
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to information on production techniques • VMGs have limited access to information such as in integrated management of red spider mites • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment for youths and those recovering from drugs exists in spraying the crop • Improved production for VMGs
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R., Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on red spider mites identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of red spider mites
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer.

<table>
<tr><td>TIMP Name</td><td>Integrated Weed Management</td></tr>
<tr><td>Crop management practices</td><td>Management practices
  </td></tr>
<tr><td colspan="2">A: Description of the technology, innovation or management practice</td></tr>
<tr><td>Problem addressed</td><td>Weeds reduce profitability in AIVs production system. They compete for nutrients, soilmoisture and space with the crop and also harbor insect pests and create an environment conducive for disease occurrence. This adds costs to production. Major weeds in AIVsproduction include grass weeds such as couch, kikuyu grass, star grass and annual weeds such as black jack, gallant soldier, mexican marigold and wandering jew. Different weeds require various strategies for effective control, hence producers should combine two or more of the methods to management weeds. Significant yield losses in AIVs production are attributed to poor weed management. Proper weed management is necessary to increase productivity</td></tr>
<tr><td></td><td>
<table>
<tr><td>Common weeds affecting AIVs production</td><td></td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Wandering Jew (Commelina Benghalensis L.) Source Hottensiah Mwangi</td><td>Double thorn (Oxygonum sinuatum (Meisn.)Dammer associating with crows foot (dactyloctenium</td></tr>
</table>
</td></tr>
</table>

		aegyptium) and *Ragwort* (*Senecio discifolia* Oliv.) Source Hottensiah Mwangi
		
	Gallant soldier (*Galinsoga parvifloraCav.*)	Blackjack (*Bidens pilosa* L.)
		

	Digitaria veluntina (Forssk.)P. Beauv.	Wild finger millet (*Eleusine indica* (L.)Gaertn.)
		
	Purslane (*Portulca oleraceae L.*) Source Hottensiah Mwangi	*Late weed* (*Trichodesma zeylanicum*) amonggrass weeds Source Hottensiah Mwangi
		
	Goat weed (*Ageratum conyzoides* L.)	Sow thistle (*Sonchus oleraceus* L.)
		
	Terere (*Amaranthus graecisans*)	Oxalis (*Oxalis latifolia* H.B.K)

		
	Chickweed *(Stellaria media* (L.) Vill.	Wild lettuce (*Launaea cornuta* (Oliv.&Hiern))
		
	Parthenium (*Parthenium hysterophorus*)	Thorn apple (*Datura stramonium* L.)

		
	Asthma weed (*Euphobia hirta* L.)	Wild raddish (*Raphanus raphanistrum*)
		
	Starbur (*Acanthospermum hispidum* DC.)	Eshaaga (*Eracustrum arabicum* Fisch.&Mey.)
		
	Chinese Lantern (*Nicadra physaloides*)	Tar vine (*Boerhavia diffusa L.*)
		
	Nutsedge (*Cyperus rigidifolius* Steud.) Source Hottensiah Mwangi	Couch grass (*Digitaria abyssinica*) Source Hottensiah Mwangi

What is it?(TIMP description)	Integrated weed management (IWM) is using of several weed approaches such as preventive, physical control, biological control, use of biodegradable mulch, cultural, mechanical and chemical control the management of weeds . Physical control is the removal of weeds manually or mechanical means, such as hand weeding or mowing. Biological control is where you graze by big animals. Chemical control is where appropriate herbicides are used to control weeds. Cultural control includes the practice of crop rotation since various crops may influence the diversity and abundance of particular weed flora. Select robust growing varieties that cover the soil and suppress weeds in rotation. Mechanical weed management includes use of farm implements e.g use of a motorized knap weeder, which does the work much faster and is less tedious. Chemical weed management involves use of pre-emergence selective herbicides and or post- emergence selective herbicides. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks).
Justification	The wide diversity of weeds affecting AIVs cannot be effectively managed by one approach such as manual approaches commonly used by majority of farmers. Whereas this is effective, it is time consuming and labour intensive. Whereasmanual weeding could be effective, it may also be ineffective when carried out under wet conditions; all weeds maybe apparently replanted. Therefore regrowth becomes a big problem. AIVs producers should therefore selectone or more approaches to keep weeds under control.  Weeds left in the intra row when using plough with draught animals can be uprooted manually.

	  Hand weeding & Back breaking labour burden in common weeding practice weeded field  Identify the weed diversity and densityto make appropriate control measure
where already promotedif any	Laikipia, Nyeri
Countieswhere TIMPs will be upscaled	Laikipia and Nyeri
Challenge s in developme nt and dissemination	High cost of herbicides Inadequate knowledge and information on which herbicides to use and when to usethem

	Myths on appropriateness of using herbicides
Suggestio n for addressingthe challenges	Promotion of the product by conducting demos and field days and involvement ofthe stakeholder e.g. agro-chemical company Develop and disseminate information to various stakeholders Training on integrated approaches using available methods, including appropriateherbicides and their use of herbicides – safety
Lesson learned inup scalingif any	That integrated approaches of weed management are more effective than use of onecontrol method and is safe on environmentally friendly. Continue use of herbicide is environmental, health and social hazard.
Social, environmental, policy andmarket conditionsnecessary for developme nt and up-scaling	Train on understanding the working of an integrated weed management.Have an environmental and safety plan when using herbicides Address the environmental and social concerns related to use of agrochemicals. A functional agrodealer network to supply the products when required by thefarmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basiccosts	Ksh 4000
Estimatedreturns	KSH 1000 per acre
Gender issues and concerns in development dissemination, adoption and scaling up	Women and youth have limited access to production resources such as land, capital to purchase some of the inputs used for IWM Women work is complicated by their multiple roles they do such as such domestic roles Women and youth have limited access to education, training and extension services Women have less access to agricultural information, technology and knowledge on IWM Women and youth have less access to knowledge and information on IWM Use of IWM technology can reduce labour from manual weeding and save time for other activities for women and children
Gender related opportunities	Women and youth to generate income from weeding Women and youth to generate income from agro dealer business Women and youth to generate income by starting cortege value addition factories due to enhanced yield There will be improved food security and nutrition from for women There will be increased job security for women and youth by spraying herbicides There will be increased production since the weed competes with plants leading to low production
Vulnerable and marginalized groups (VMG) issues and concerns in	VMG groups could have limitations in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes. VMG have less access to extension training as they are not given equal opportunities

development, dissemination, adoption and scaling up	VMG have less access to knowledge and information on IWM VMG have less access to capital to purchase herbicides
VMG related opportunities	VMG to generate income from agro dealer business VMG to generate income by starting cortege value addition factories due to enhanced yield There will be increased production leading to increase food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Successstories	
Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires	Ready for up scaling
validation;3. Requiresfurther research)	
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organizati on andscientists	KALRO , Kabete Dr Hottensiah Mwangi, Dr Jedidah M. Maina, Charity, W. Muchira, Dr. RuthAmata, Dr Violet Mumanyi
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, CountyGovernments, KEPHIS

Research Gaps:
Determine cost benefits of using motorized knap weeder versus other IWM in AIVs production

3.3. TIMP Name	**Land Preparation Practices to control weeds in AIVs**
Category (i.e. technology, innovation or management	Management practice

practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	A weed biodiversity infests in AIV cropping systems that contributes to poor crop and yield loss across the agro ecological zones in Kenya.  Poorly prepared land Unprepared Land
What is it? (TIMP description)	Land preparation covers a wide range of practices from zero-tillage or minimum tillage through to conventional ploughing using hand hoe, ox plough or tractor. It typically involves (1) plowing to "till" or dig-up, mix, and overturn the soil; (2) harrowing to break the soil clods into smaller mass which exposes weeds seeds from seed banks. Land preparation can be by ridging's which can be done manually or mechanized by use of tillers. It is done during the dry weather when soils are easier to work to make save site for AIVs seeds. We recommended this to be 3-4 weeks before the rain commence. For no till choose appropriate herbicides and follow the manufacturers label and recommendations specific to each herbicide. Apply post emergence on vigorously growing weeds to clear the difficult to control weeds such as couch grass, nut sedges among others. The most common herbicides used is Glyphosate with trade names such as Round up, Glycel, Kausha, weedal.
Justification	Land preparation is important to control weeds and ensure that the AIVs field and ready for planting and also facilitate obtaining a uniform crop depth resulting to almost uniform germination. This enables to minimize yield loss and increase productivity because AIVs are poor competitors. It controls weeds, and provides a soft soil mass suitable for direct seeding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers in all AIVs suitable regions
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Land preparation using pre-emergence in steep areas can lead to soil erosion and herbicides getting to water tables. Train producers on available options using practical

	demonstrations Participatory field days with farmers groups and stakeholders Provide communication products eg brochures
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, Tractor/Plough service providers, NGOs, Research organization (KALRO, CIAT)
C: Current situation and future scaling up	
Counties where already promoted. if any	Conservation Agriculture/Minimum Tillage for land preparation in laikipia,Nakuru, Tractor ploughing in Nakuru, Laikipia, Trans Nzoia, Bungoma, Bomet, Narok, Nandi, Kakamega
Counties where TIMPs will be	All suitable areas
Upscaled	
Challenges in development and dissemination	• Limited biological knowledge on weeds such as couch grass. • Small land holding limiting tractor mechanization • High cost of using mechanized options
Suggestions for addressing the challenges	• Promotion of the low cost mechanization technologies where possible. • Tractor hire service by County and other serviceproviders • Training for land preparation to control weeds under no-till, minimum tillage and farmers practice.
Lessons learned in up scaling, if any	Good land preparation minimises weed infestation, results to increased yield and moisture retention especially where ridging is practiced and weeds sprayed post emergence herbicides.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Land size and topography influences choice of land preparation method to manage weeds. • County tractor subsidy program can help promote mechanization for land preparation. • Use of small hand tractors hould be made accessible, affordable and easier to operate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 4,500 per acre
Estimated returns	6000-7000 Ksh
Gender issues and concerns in development, dissemination, adoption and scaling up	• Use of low cost land preparation technologies that are affordable to women farmers • Promote labour saving technologies to benefit women who are major players on land preparation • Land preparation during dry period to ensure weeds dry up and subsequent operations easier and cheaper.

	• Early land preparation exposes the pest and diseases to the hot sun hence reduced build up of inoculum • Explore use of herbicides to kill weeds and save labour
Gender related opportunities	• Ensure Opportunities for using low cost, low labour land preparation technologies that does not exclude women.
VMG issues and concerns in development, dissemination, adoption and scaling up  	• High cost of land preparation • Access to the mechanized options for land preparation. • Some management practices such as Conservation Agriculture (CA) is friendly to the VMGs • The project should have provision on training of the youths
VMG related opportunities	• Group land preparation by VMG • There is a business opportunity for the for the youth using low cost mechanization- e.g. ox-ploughs, walking tractors in land preparation service enterprises
E: Case studies/profiles of success stories	
Success stories	Farmers in Embu and Nyeri have realized higher returns after this practice and have attained Lucy Waihiga who
	increased yield from 45-180kg from ¼ acres
Application guidelines for users	The small walking tractors are available in the Counties and training on use of small equipment and mechanization
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Katumani, KALRO Embu
Lead organization and scientists	KALRO Katumani
Partner organizations	KALRO, CIAT-PABRA, Seed Companies, Mechanization partners e.g. Ikonic, Hello Tractor, Conservation Tillage Network in Nairobi

TIMP Name	**Legume Intercropping System**
Categories (i.e. technology innovation Or management practice)	Innovation Picture **Legume AIVs intercrop**
A: Description of the technology, innovation or management practice	
Problem addresses	Weeds invading the bean fields competiting for resources nutrients, water and space. Planned inter-cropping of beans with other crops - cereal (maize or sorghum) tubers (cassava), bananas, cash crops (coffee) gives returns. Poor intercropping results in low yields attributed to competition for light and nutrients and may lead to increased infestation of pests and diseases. Good intercropping to effectively control weeds

	Cowpea finger millet intercrop  requires specific spacing, the right variety of legume depending on growth habit of the intercrop. Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition.
What is it? (TIMP description)	Innovative Legume Intercropping Systems is the application of growing more than one crop in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use. Intercropping systems are defined based on the temporal and spatial arrangements of the crops.There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Innovative AIV intercrop  Cowpea millet-sorghum intercrop

Justification	Cropping of several AIVs plant species together reduces negative effects of amonoculture and thus is commonly employed in ecological agricultural
	systems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is compatible with the principles of balanced agriculture. Intercropping systems provide better soil cover hence reducingweed incidences. Intercropping has important advantages in regard to efficient land use, increasing crop productivity and monetary returns thanks to effective use of various inputs compared to sole cropping. It can significantly increase total productivity as compared to sole cropping thanks to better utilization of water,nutrients and solar energy. Crops in these systems use available resources more efficiently thanks to different rooting and canopy properties which component plants species exploit resources complementary. Intercropping systems can cause more effective use of resources by providing symbiotic nitrogen from legumes, or making available inorganic phosphorus fixed in soil because of lowering of pH via nitrogen fixing legumes. Intercropping systems is a climate adaptation strategy in case of crop failure in mono cropping and is considered as one of the most dependable ways to maintain the sustainability of crop production. It is a risk mitigation strategy by farmersin light of prevailing climate change. Intercropping practices can ensure higher yield as well as productivity and profitability in crops per unit land. Intercropping systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources andprofitable than mono-cropping systems. Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, and color and trapping effects between intercropsinfluence insect or disease situation or their natural enemies. Crop rotation and intercropping practices decrease weed population density and biomass yield Success of intercropping systems over sole cropping can be achieved by careful agronomic manipulations and planning schedules. These manipulations include planting time, plant density, available resources, intercropping patterns, Spatial arrangements, and harvest times.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Conduct demos band the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)
C: Current situation and future scaling up	
Counties where already	Altitude areas of 1,500-2,000 above sea level ie Bomet Nakuru, Laikipia, Nyeri, Kirinyaga, Murang'a, Bungoma, Kakamega, Siaya, Trans Nzoia, Uasin

promoted if any	Gishu.
Counties where TIMPs will be up scaled	Nyeri and Laikipia
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	Facilitation of training of county extension staffs Demos and field days
Lesson learned in up scaling if any	Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promoting in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	Women migtght not be aware that Legume AIVs intercrop is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for Legume AIVs intercrop Need to train, especially women, on how to implement the Legume AIVs intercrop systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs might not be aware of the use Legume AIVs intercrop in weed management VMGs have no finances so they might not have funds to purchase some of the input used for Legume AIVs intercrop Legume AIVs intercrop systems impede mechanization of the production system
VMG related	System diversification and yield stability will increase food availabilityleading

opportunities	to food and nutrition security at household level Improved income from production and marketing of beans and other crops-diversified incomes
E: Case studies/profiles of success stories	
Success stories	Nyamira, Kakamega, Siaya, Trans Nzoia, Uasin Gishu.
Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Require validation
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800,Nairobi
Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi, Dr Jedidah Maina and Charity W. Muchira.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

3.6. TIMP Name	**AIVs Intercropping**
Categories (i.e. technology innovation Or management practice	Management practices
A: Description of the technology, innovation or management practice	
Problem addresses	Low yeld production,in AIVs.
	Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing smoother weeds.
What is it? (TIMP description)	Intercropping of AIV is the practice of planting AIVs between other crops between rows such as cereal (maize, millets), tubers (cassava), and bananas. Intercropping must be planned to use space available and smother the weeds.

Justification	Cropping of several plant species together reduces negative effects of a monoculture and thus is commonly employed in ecological agriculturalsystems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is sustainable practice. Intercropping has important advantages in regard to efficient land use, It can significantly increase total productivity as compared to sole cropping to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently to different rooting and canopy properties which component plants species to exploit resources complementary. Success of intercropping systems over sole cropping can be achieved by some agronomic manipulations. These manipulations can be plant density, planting time, available resources and intercropping patterns. Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV producer, Seed producers, Extension staff
Approaches used in dissemination	Extension publications (posters/ brochures/leaflets) Partners -NGOs Demonstrations and field days, Agriculture shows/trade fairs and distribution of small sample, farmer participatory evaluations Seeds of Gold, Mass Media – e.g. Mkulimaprogramme, Smart Farmer
Critical/essential factors f orsuccessful promotion	Availability of seed, Conduct demos and the field days with farmers groups and stakeholders
Partners/stakeholders f orscaling up and their respective	County extension staffs, NGOs, Private sectors e.g. seed company, AIVsvalue chain service providers
roles.	
C: Current situation and future scaling up	
Counties where already promoted if any	Altitude area of 1500-2000 meters above sea level Bomet, Nakuru, Laikipia, Nyeri
Counties where TIMPs will beup-scaled	Laikipia and Nyeri
Challenges in development anddissemination	Inadequate AIVs seeds Inadequate information to stakeholders on optimal spacing options for the different varieties for the different AEZ
Suggestion for addressing thechallenges	Train the stakeholders and youths in seed production Conduct demos and field days to demonstrate on benefits of intercropping and also mono cropping correct spacing through use Farmer Field Business School (FFBS) and Agricultural Innovation Platforms (AIP)
Lesson learnt in scaling, if	Farmers who have learnt of the technology through field days and

any	demos are currently user of the new technology. Alternative method (mechanization - planter) may lessen the work Capacity building and awareness campaign on proper spacing and intercropping are required.
Social, environmental, policyand market conditions necessary for - developmentand up-scaling	The technology is socially acceptable, good for environment, and the market irs ready for development and up-scale. The practice minimizes the use pesticides and surface run off since they also act as cover crop
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice although it has a limitation of using herbicides. The weeds get suppressed by the canopy cover.
Estimated returns	Considering the land equivalent ratio the return are expected to be higher in the intercrop being done at subsistence level for foodsecurity. If the focus is business oriented and mechanization is employed it may bring the cost of production lower.
Gender issues and concerns indevelopment, dissemination adoption and scaling up	Women migtght not be aware that AIVs intercropping is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for AIVs intercropping .Need to train, especially women, on how to implement the Legume AIVs intercropping systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues andconcerns in development, dissemination, adoption andscaling up	VMGs might not be aware of the use Legume AIVs intercropping in weed management VMGs have no finances so they might not have funds to purchase some of the input used for AIVs intercropping Legume AIVs itercropping systems impede mechanization of the production system
VMG related opportunities	System diversification and yield stability will increase food availabilityleading to food and nutrition security at household level Improved income from production and marketing of beans and other crops-diversified incomes
Gender issues and concerns indevelopment, dissemination, adoption	Operations in row planted with AIVs are easier. Training on optimum training should target majorly women who are the ones who play key role. .

and scaling up	
Gender related opportunities	Optimum spacing and row planting opens space for mechanization, which would reduce drudgery this benefiting the women.
VMG issues and concerns in development, dissemination, adoption and scaling up	Information needs on spacing Training of farmers on optimum spacing
VMG related opportunities	Service provision for mechanized planting of beans Extension support to other farmers
E: Case studies/profiles of success stories	
Success stories	Some farmers in Kieni in Nyeri County have moved from 1 bag to 4 bags (90kg bag) Farmers have reported improved soil conditions, reduced runoff and buildup of nutrient loss, soil moisture retention in the soil and generally an increased crop production following application thepractice.
Application guidelines f orusers	Extension and training material available such as brochure
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO EMBU Vice Chancellor University of Nairobi Kabete CampusVice Chancellor, Egerton University
Lead organization andscientists	KALRO Embu – Catherine Muriithi and Dr Alfred Micheni Egerton University- Prof Paul Kimurto University of Nairobi –Prof Paul Kimani
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed ,NGOs, CBOs, County Governments, KEPHIS

TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds infestation, soil moisture and loss of organic matter, in ASAL.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials or synthetic materials to control weeds fromseeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or

	natural mulches including straw, dead leaves and compost to make
	more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used in growing for long season AIVs. Only black mulches should be used to control weeds. Benefits: Organic mulches suppress weeds while retaining moisture in the soil; keep the soil cool; improve soil fertility (as the mulches decompose) and improves microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weedseedlings and weed seeds.
Justification	Organic mulching has added benefits other than minimizing weeds infestation, it facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing rain drop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable and effective in weed control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	- Farmer field schools - On-farm demonstrations during farmer field schools - Training in workshops
Critical/essential factors for successful promotion	Organic: - Availability of plant or crop residues for organicmulches. - Size of the land. - Competing uses of crop residues. - Type of the crops Synthetic Cost of materials Disposal of material after use.
Partners/stakeholders for scaling up	County government extension services; Provide link with
and their roles	Farmers Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	Not used in beans in Kenya. Used in Thailand.
Current extent of reach	Available and practiced in different commodity value chains
Counties where TIMP will be promoted	Where beans are a priority value chain. All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competinguses in organic mulches. • Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.

Suggestions for addressing the challenges	• Crop diversification to increase availability of organicmulches. • Establish and follow a good integrated pest controlmanagement program for the particular beans. • Adapting alternative mulching materials like high absorbance polymers in AIVs.
Lessons learned	There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	Mulching work is mainly done by women who have any other roles creating more work for them Women might not be aware that mulching is used as a weed control Women have limited access to productive resources such as land so they might not have enough residues to do mulching The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	There is potential of reduced workload for women Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is labour intensive for VMGs, hence its adoption and scaling up is a challenge. VMGs have limited access and control of productive resources such as land The VMGs have no finances to pay hired labor due to limited access to credit facilities
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice Improves food production and nutrition for VMGs.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.

Application guidelines for users	User guidelines are dependent on value chain 1.Plant AIVs in clean seed bed 2 Apply mulch between the rows of AIVs. Mulch management Pull or kill weeds that grow out of the mulch near the AIV plant.
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further Research	Ready to use.
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira, Dr v Mumanyi
Partner organizations	County governments Public-Private-Partnerships

Research Gaps:
Determine cost benefits of using biodegradable biological and plastic mulch versus other IWM strategies in AIVs production

2.7.4 TIMP Name	**Chemical Weed Control**
Category (i.e. technology, innovation ormanagement practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Heavy weed infestation in AIVs fields
What is it? (TIMP description)	Chemical weed control refers a technique that involves the application of herbicide to control the growth of weeds or to soil to kill emerging weedseedlings and/ or weed seeds. Herbicide technology requires knowledge on herbicides required for specific crops, weeds occurring and the environmental conditions in the cropping system. Use ONLY Recommended herbicides where need be. .
Justification	Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and effects can be timely weed control.
Region promoted	Limited use of herbicide among small scalefarmers
Counties where TIMP will be upscaled	Herbicide weed control can be upscaled inall the areas where beans are being grown.
B: Assessment of disseAIVs mination and scaling up/out approaches	

Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of chemicals
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successfulpromotion	Capacity building and training on safe useof chemicals for all users
Partners/stakeholders for scaling up andtheir respective roles	• Public and private partners –[MOALF&I)for extension, • Chemical companies for back stopping • ICRISAT for technical backstopping and promotion; • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro- finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Validation of these herbicides needs to be done before recommendations are given to the farmers.
Challenges in dissemination	Limited knowledge and information and low literacy levels among the farmers. Limited technical knowhow and knowledge on herbicide use and application which requires training for effective and safe use.
	The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing thechallenges	There is need to train the agricultural extension county officers as TOTs on safe use of herbicides. This help in reaching the farmers with the information. Herbicides like all chemicals have to be used with care to avoid environmental and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for guidance on safe use of chemicals
Lessons learned	Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under

	cultivation and increase productivity.
Social, environmental, policy and marketconditions necessary	Sensitization of communities on alternative methods of weed control and safe use ofchemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Herbicide use is cheaper than manual weedcontrol because it requires less labour.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Women and children are the main sources of labour in in AIVs farms • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities. • Women and youth have limited access to productive resources such as credit to buy weed control chemicals • Women and youth have limited access to education, training and extension services and on new technologies such as weed control chemicals • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels on types of chemicals to use at the farm level • Women have limited access to information, technology and knowledge on stalk disposal as compared to men • Women have got limited access to funding as compared to men to purchase the weed chemicals • There is slow information and awareness flow to female farmers due to their low academic levels
Gender related opportunities	• . The technology would create employment for the youth and women within the potatoes value chain • Youth could form groups and engage in spraying weed using weed control chemicals • The adoption of the TIMP will lead to reduced work for women as it will attract men into engaging into weeding There will be increased yields and sales leading to improved food and nutrition security
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit to access fertilizers and farmyard manures. • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	• Use of herbicides will improve weed management leading to increased productivity, increase availability of AIVs for

	consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
E: Case studies/profiles of success stories	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to containers on how to use.
F: **Status of TIMP Readiness (**1. Ready forup-scaling; 2. Requires validation; 3. Requires Research **)**	Requires validation and more research
G: Contacts	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr.Jedidah Maina, Charity W. Muchira.
Partner organizations	ICRISAT Nairobi; MoALF in Counties ,Chemical companies

Research Gaps:
Determine cost benefits of using chemicals versus other integrated weed management strategies inAIVs production

2.7.5 TIMP Name	**Mechanical weeding**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeding labour and timeliness in Weed management.
What is it? (TIMP description)	This is where an implement is used to weed after having planted clean certified seeds in weed free well prepared ground Planting should be done in rows to facilitate interrow weeding. Two weedings at 15 and 30 days after sowing (DAS) 2) **Row Weeders (Manual/ motorized)** These implements are used to weed between the rows. The intra row weeds are removed by hand pulling.
Justification	Weeds if not controlled will cause yield losses due to competition. The weeds will also hosts insects pests and pathogens increasing cost of production. This Lowers

	quality of the produce and reduces productivity..
Region promoted	All areas where AIVs grown
Counties where TIMP will be upscaled	All counties growing AIVs
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation. Field days, Shows, Farmer to farmer communication, Leaflets, Larger plot demonstrations.
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Jua Kali artisans • Processors and manufacturers to create market for produce, aggregators e.g. CARD(Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Limited research done on gender responsive weeding implements i.e row weeders are heavy and can only easily be handled by men
Challenges in dissemination	Implements not readily available in The market.
Recommendations for addressing the challenges	Work with Jua Kali industries for fabricationof appropriate implements.
Lessons learned	Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the available technologies and management practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of the weeder (implement is high - 28,000 for ordinally bean farmers, they can purchase as a group.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Mechanical weeding is labor intensive for all gender especially for women

	• Weeding increased labour for women who are already overburdened by their multiple gender roles • Women and youth have limited finances to pay labor services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in AIV farms • Women and youth have limited access and control of production resources such as land, credit to purchase farm equipment • There is need to equip women, youth and stakeholders with information relating to mechanical weed control method • There is also need to sensitize all genders on the losses caused by weeds and the importance of timely weed control.
Gender related opportunities	• Timely weeding will lead to increased potatoes production • There is a potential of creating employment for women and youth at various nodes of potatoes vale chain • Increased potatoes production will lead to increased household incomes and improved food security. • Mechanical weeding reduces labour for women as men are attracted to participate in weeding also
VMG issues and concerns in development , dissemination adoption and scaling up	• Mechanical weeding is not friendly for VMGs as it is labour intensive • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG related opportunities	• Increased production will improve food security and nutrition for VMGs • If adopted the VMGs will get employment at various nodes of AIVs value chains • There is potential for increased incomes for VMGs
E: Case studies/profiles of success stories	

Success stories	Not yet accessible to bean farmers.
Application guidelines for users	Production manuals to include weed management TIMPs
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requiresfurther research**)**	1) Ready for up-scaling 2) Rower weeder is heavy so not friendly to women users. Research on gender sensitive weeders.
G: Contacts	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr. JedidahMaina, Charity W. Muchira, Dr. Ruth Amata
Partner organizations	ICRISAT Nairobi; MoALF in Counties

Research Gaps:
Determine cost benefits of using mechanical weeding tools e.g motorized knap weeder versus other Integrated weed management strategies in AIVs production

2.7.6 TIMP Name	**Safe Use of Agrochemicals**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Excessive pesticides application to crops, use of pesticides for spraying crops without wearing the right protective clothing, storage of pesticides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use of pesticides without following the guidelines provided on the labels. Inadequate enforcement of global policies and regulation on use of pesticide all lead Environmental, health and social concerns and problems affecting many AIV producing regions.
What is it? (TIMP description)	This is a practice of Capacity building stakeholders, crop protec tion teams on safehandling, application, use of pesticides right from transportation from
	the agro-dealers to storage in a special store, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large and community sorrounding. The management practice will include proper methodologies for pesticide disposal to minimize pollution of the environment.
Justification	Although cases of improper use of pesticides are very common in most of the areas where AIVs is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the

	water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users and stakeholders'to be made aware of the best practices that should be used for save handling of pesticides. There has been reports of increase of chronic diseases in human beings attributed to pesticide misuse and safe use capacity building can reduce social, environmental costs of diseases
B: Assessment of dissemination and scaling up/out apprisoaches	
Users of TIMP	Farmers, AIV Producers
Approaches used in dissemination	Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinic, Pesticides spray Demonstrations
Critical/essential factors for successful promotion	Collaboration between all partners, willingness of farmers to adhere to proper guidelines Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers farmer groups/CBOs to participate in the implementation of the variousAIVs training on weeds management, KALRO and Universities to develop the technologies and conduct ToTs. CABI, AAK, PCPB, KEPHIS participate as stakeholders.
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	Nakuru, Trans Nzoia, Kakamega, Bungoma, Machakos, Makueni, Nyeri, Laikipia
Counties where TIMPS will be up scaled	All regions suitable for growing AIVs
Challenges in dissemination	• Change of mindset in favour of current practices maybe difficult to achieve, • Illiteracy and inadequate capacity to use pesticides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of pesticides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose pesticides properly
Suggestions for addressing	• Capacity building and sensitization forums for both farmers
the challenges	and agro dealers using participatory approach • Formation of youth spray teams • Establishment of aggregation centres for pesticide containers • Establishment of training of Extension staff and lead farmersas TOT • Increase surveillance along the border points and enforce thelaws_
Lessons learned in upscaling if any	Upscaling of this technology needs young men and youth due toits hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collectionand incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.

Social, environmental, policy and market conditions necessary	Organized collective marketing channels and trainings are critical are for benefits tobe derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 60,000 per acre
Estimated returns	KES 500, 000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	• Technology is not safe for use by expectant women and the physically challenged individuals because of it hazardous/dangerous nature • Pesticides and protective gear are expensive and most women may not afford them • Lack of knowledge by men and women on the dangers of chemicals especially on storage and disposal • Low levels of illiteracy and inability to read and interpret the content of the herbsides labels especially on re-entry period after spraying and PHI. This cause herbecides poisoning to men and women who spray and harvest the AIVs
Gender related opportunities	• Formation of spray teams by men • There is reduced labour for women • Formation of spray teams by men and youths hence creating employment for the youth • The use of safe chemicals in weed management and control attracts men in weeding which traditionally used to be done by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• These are dangerous products that may not be handled by vulnerable groups • These are dangerous products that may not be handled by vulnerable groups. • Herbicides are expensive for VMGs to afford • VMGs have limited access to productive resources such as land, credit to access farm inputs such as herbicides • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	• Safe use of herbicide can easily be undertaken by the VMGs as employment where by they can form herbicide spray teams in the wards in each county and they charge for services provided • VMGs have the potential of operating agro-vets to stock farm inputs such as herbcides, pesticides, fertilizers among others • The use of weed control chemicals contributed to reduced labor burden for VMGs
E: Case studies/profiles of success stories	
Success stories	• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people

	being exposed to pesticides • There are reported cases of farmers who regularly scout their crop that have reported to using less pesticides on their farm • Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction ofthese containers on farms • Safe use of Pesticide campaigns by AAK, PCPB KALROand MOLF&I have
Application guidelines for users	Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Develop techninician and youth spraying teams with pesticide decision guidelines, manuals, brochures developed by KALRO and other stakeholders as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling;
F: Contacts	
Contacts	Centre Director KALRO Kabete
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr Jedidah M. Maina and Charity W. Muchira. Dr. Ruth Amata
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

Research Gaps:
Management of troublesome perennial grass weeds and sedges in AIVs.

5.7 Mechanization of AIVs Production Activities

11.6.1 TIMP Name	**Power tiller**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIV commodity • Delayed operation lead to late planting • High cost of manual labour • Inconsistent land preparation

What is it? (TIMP description) Ploughing tractor 14HP  (source: KALRO-Katumani	A Power Tiller is a two-wheeled agricultural implement fitted with rotary tillers, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 1ha per day by one operator in about two hours. This will vary depending on the climatic conditions, soil types, soil moisture content, stamina and experience of the operator. Fuel consumption is about 15 liters per ha. Though these results varies with the technical ability of the operator.
Justification	It has multiple uses and other advantages. Power Tiller helps in preparing the soil, sowing seeds, planting seeds, spraying the fertilizers, herbicides and water. In addition to it also helps in pumping water, harvesting, weeding and transporting crops. A power Tiller is ideal where the land size is small. Farm sizes average less than one hectares which limit turning ability of conventional tractors while manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of the machines • High initial cost for small-scale farmers to import or when fabricated.
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000

Estimated returns	180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Power tiller is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment due to lack of finances due to limited access to credit facilities • AIVs Power tiller should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Power tiller increases participation of household members in working in AIVs farms that is women, men and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating power tiller is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the equipment • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Power tillers need to be designed in such a way which would enable people abled differently to operate it • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani;

	P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, 0733812953
Partner organizations	Local Fabricators

11.6.2 TIMP name	**Wheeled Tractor less than 50Hp**
Category (i.e. technology, innovation ,or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIVs commodity • Drudgery and fatigue • Low output • Inefficiency and inconsistency of work. • Untimeliness • High cost of manual labour
What is it? (TIMP description) 	A tractor is an engineering vehicle specifically designed to deliver a high tractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) tillage, trailer towing, planting, weeding, ridging, planting, spraying, harvesting, ground grading and much more agricultural functions. Agricultural implements may be towed behind, mounted behind or in front of the tractor and the tractor may also provide a source of power if the implement is mechanized. It is therefore fitted with various equipment at alternate times for easing farm operations
Justification	A Tractors is an essential necessity of farming as it provides machine power for performing farm applications. In addition to routine farm activities, it is efficient, timely, consistent, releases labour and reduces cost as compared to manual labour. With a small horse power of 50, it is affordable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage

Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the tractors • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying a tractor • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	Organized producers' groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Tractor – KES 1,500,000 Plough – KES 350,000 Harrow – KES 400,000
Estimated returns	2ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• The wheeled Tractor less than 50Hp is can be used by all • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities such as Wheeled Tractor less than 50Hp • Men dominate most decisions at the household and community levels hence they make decisions relating to land preparation for AIVs and also on equipment to be used in the farms • AIVs farming machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • The is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	• Creates employment especially for women and youth • Reduces drudgery for women farmers as well as men • Promotes inclusivity of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating Wheeled Tractor less than 50Hp is complex for some VMGs especially those who are abled differently

	• VMGs have less access to agricultural information, technology and knowledge hence they might not know where to get such tractors • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to purchase the tractor since it is affordable and easy to maintain machines
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs • Promotes inclusivity of all genders
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Traders, Processors

TIMP name	**Mould board plough**
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Unbroken heavy clods in the soil and gives it an uneven structure. • Uneven plough depth • Requirement of added weight for ballasting by disc plough.
What is it? (TIMP description)	Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow

 Source; captain tractors pvt. Ltd	slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation. The plough conserves moisture and biomass while pulverizing the soil hence climate smart.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is Versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Kirinyaga, Murang'a
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying the plough • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials • Organized marketing channels

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Plough – KES 380,000
Estimated returns	5 year working
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in their farms • Mouldboard plough can be used by all genders including women • Mould board plough AIVs equipment is expensive for women to purchase • AIVs farming machines should be designed for easy start and operation by all gender. • There is need to equip women, youth and stakeholders with information relating to the Mould board plough • Linking the women and youth to financial institutions would enable them to buy since it is affordable and easy to maintain machines
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating mouldboard plough is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence might not be aware of mould board plough • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMGs
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology can be easily utilized by all gender categories (especially women and youth)
Gender related opportunities	• It offers good opportunity for commercial venture that can empower all gender categories
VMG issues and concerns in	The technology can be easily utilized by all VMGs

development, dissemination, adoption and scaling up	
VMG related opportunities	Offers opportunities for lucrative commercial venture by VMGs
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.3 TIMP name	**Disc Harrow**
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in a commercialized AIVs commodity • Difficult to break clods manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)  Source; https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.sv	A harrow, farm implement used to pulverize soil, break up crop residues, uproot weeds and cover seed. It is a farm implement used for surface tillage. It is used after ploughing for breaking up and smoothing out the surface of the soil. The purpose of harrowing is to break up clods and to provide a smooth soil structure, called tilth, that is suitable for planting seeds. Coarser harrowing may also be used to remove weeds and to cover seed after sowing.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is versatile. The

	various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying the harrow • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials • Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Harrow – KES 350,000
Estimated returns	3 year working
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Disk Harrow can be used by all genders but it is expensive to purchase by stakeholders especially by women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women and youth have limited access to education, training and extension services than men

	• Men dominate most decisions at the household and community levels hence determines the type of equipment to be used in AIV farms • AIVs cultivation is associated with women although some productive resources are owned by men such as farm equipment this being the men might not purchase the disk harrow since they have no interest in AIVs • There is need to equip women, youth and stakeholders with information relating to the AIVs disk harrow
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating a disk harrow is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not be aware of the existence of a disk harrow and how it is operated • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Farm machines need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordability and easy to maintain machines for all types of farmers
VMGs opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMG farmers
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University

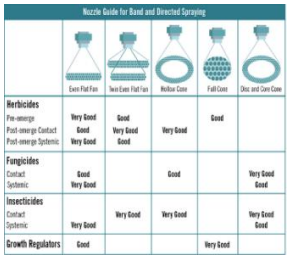
	Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.4 TIMP Name	**AIV Planter**
Category (i.e. technology, innovation or management practice)	Innovations
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of planting, in the commercialized AIV commodity. High seedling density hence need for labour in thinning. High cost of Manual labour .
What is it? (TIMP description) 	A seed drill is a farm implement that sow seeds at a desired seeding rate and depth, ensuring that the seeds are covered and compacted under soil. This saves them from being eaten by birds and animals, or being dried up due to exposure to sun. With seed drill machines, seeds are distributed in rows, however the distance between seeds along the row can be adjusted by the user. This allows plants to get sufficient sunlight, nutrients, and water from the soil. A Seed Drill is designed to provide the flexibility to configure the planter to suit your requirements. Features including powder coated large capacity seed and fertilizer boxes which can sow a large range of seeds and fertilizers from both boxes. The seeding/fertilizer rate can be infinitely varied simply by moving a lever. The boxes also have a clean out plate for easy clean out.
Justification	To make AIVs production activities less tedious and more effective. Attract the youth to agribusiness through operation of the machines. Before the introduction of the seed drill, most seeds were planted by hand broadcasting, an imprecise and wasteful process with a poor distribution of seeds and low productivity. Use of a seed drill can improve the ratio of crop yield (seeds harvested per seed planted) by as much as nine times Sikander et al., 2003.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up and their roles	KALRO, universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted	Machakos

if any	
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • Lack of capacity for small-scale farmers to purchase
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if any	• Mechanization in agriculture increases production through efficient operations • Timely planting
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	485,000.00
Estimated returns	5ha/hr
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIV planter is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment as they lack finances due to limited access to credit facilities • Women have limited access to agricultural information and extension services hence they might not be aware of the existence of the AIV planter • AIV planter should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • AIVs planter increases participation of household members in working in AIVs farms that is women, men and youth • Adoption of AIV planter reduces loses incurred due to poor planting of AIVs reading to some being eaten by birds and others being burnet by the sun

VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating AIV planter might be complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the AIV planter • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • AIV planters need to be designed in such a way which would enable people abled differently to operate • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs • Reduces losses incurred during planting of AIVs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.5 TIMP Name	**Motorized Sprayer**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of planting, in the commercialized AIVs commodity • High seedling density hence need for labour in thinning

What is it? (TIMP description)   (Source; Nasirembe, Katumani, 2021)	A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides and fertilizers on agricultural crops Sprayers are man-portable units typically backpacks with spray guns They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron e.g. as well as foliar fertilizers.
What is it? (TIMP description)	Pest reduce yields up to 98% and are a major menace in agricultural production. Before AIVs forms a canopy, broad leafed weeds compete with Cabbage seedling for nutrients and light greatly reducing their yield. A manual sprayer is labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency
Justification	To make AIV production activities less tedious and more effective. Attract the youth to agribusiness through operation of the machines. With a motorized knapsack, a farmer is able to spray 4 times more in a day compared to the manual one. The farmer can also use the sprayer to spray livestock to control pests
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • High cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	Local fabrication of affordable AIV production machines
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and	• Creation of awareness on mechanization importance in

market conditions necessary for development and up scaling	the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer – KES 56,000
Estimated returns	0.5ha /hour
Gender issues and concerns in development, dissemination, adoption and scaling up	• Motorized sprayer is designed for easy start and operation . • Women and youth have limited finances to pay services and to purchase farm equipment such AIVs motorised sprayer due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization hence might not be aware of the existence of motorised sprayer • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • With the introduction of motorised sprayer men have been drawn weeding in AIVs farms, weeding was predominantly done by women before the introduction of the machine.
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It promote gender inclusivity reducing the work load for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Operating a motorized sprayer is complex for some VMGs especially those who are abled differently • AIVs machines need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs farmers • It promote productivity hence providing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as Maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Requires further research
G: Contacts	

Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.6 TIMP Name	**Power weeder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIV • Quality of leaf
What is it? (TIMP description)  (Source: Shakti Industries)	Power weeder is a device used for removing the weeds, stirring and pulverizing the soil and for loosening the soil after the crop has begun to grow. It is a self-propelled power weeder with a fully functional gear box having one forward and reverse gear transmission with clutch. It is suited for small and large scale AIVs farmers
	weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make AIV weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. Hand weeding is tedious and time consuming while manual operations are timewasting and expensive.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage

Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIV knapsack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs power weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs power weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs power weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the TIMP • AIVs power weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs power weeder due to limited access to credit facilities • Operating a AIVs power weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP • AIVs power weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.7 TIMP Name	**Back Pack Weeder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIVs • Quality of leaf
What is it? (TIMP description)	It is a hand held machine that simultaneously cut the soil and weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.

	
Justification	To make AIVs weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local Industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs Back Pack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr

	weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs back pack weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs back pack weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs back pack weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the AIV back pack weeder • AIVs back pack weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs back pack weeder due to limited access to credit facilities • Operating a AIVs back pack weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP • AIVs back pack weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani;

	P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953

TIMP Name	**Back AIVs Harvester**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of Manual weeding and winnowing of AIV Quality of leaf
What is it? (TIMP description)  (Source:https://www.alibaba.com/product-detail/Convolvulus-harvester-spinach-harvester-and-Leaf_1600070046703.html?spm=a2700.7724857.0.0.141c1e66be7uVP)	It is a hand held machine that simultaneously cut the vegetable leaves and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to harvest specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc. It runs on electricity not to contaminate the crop. Electric motor drive, no pollution, low labour intensity. Has a wide and flat cutting table, Independent unit control for cutting and walking conveyer, easy to operate; With High efficiency, cutting, transportation, collection in one machine and can harvest multiple vegetables, for example:
Justification	To make AIVs weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the

	farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs harvester KES 597,600 per unit
Estimated returns	• Capacity 0.25ha/ hour, 0.003kW /hr Harvesting charges: KES 1,600 per hectare
Gender issues and concerns in development and dissemination	• Back AIVs harvester can be used by all genders but it is expensive for AIVs to afford especially women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm equipment such as back AIVs harvester • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in harvesting AIVs • Back AIVs harvester should be designed for easy start and operation. • There is need of up-scaling back AIVs harvesters and all the genders should be targeted
Gender related opportunities	• Reduced labour intensity in harvesting • High productivity is increased leading to increased food security and nutrition • Creates employment especially for women and youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as Back AIVs harvesters due to limited access to credit facilities • Operating a Back AIVs harvester is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the Back AIVs harvester • Linking the VMG to financial institutions would enable them to buy Back AIVs harvester since it is affordable and easy to maintain machines

	• Back AIVs harvesters need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• Reduced labour intensity in harvesting for VMGs • High productivity which leads to increased food security and nutrition • Creates employment for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIVs contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Require validation
S validation	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors
Partner organizations	JKUAT, MOA, Tractor hire service contractors

5.8 African Nightshade Postharvest Handling

2.8.1 TIMP Name	**African nightshade sorting and grading**
Category (i.e. technology, innovation or management practice	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Harvesting of mature cowpea leaves results in a mixture of vegetables of poor quality and ungraded leaves
What is it? (TIMP description)	• Sorting is removal of infected vegetables, vegetables with yellowing spots, weeds and debris. • Grading is grouping of vegetables according to leaf size, weight, maturity, turgidity, physical damage, and market demand

Justification	Sorting helps to eliminate vegetables of poor quality and prevent cross contamination between infected and clean vegetables. Vegetables of superior quality fetch higher prices in the market. Grading of African night shade enhance better market that offer better prices
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increasing awareness on the benefits of sorting and grading among value chain actors, postharvest trainers, well-organised farmer groups
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling and value addition of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on vegetable postharvest handling • Green grocers and vegetable sellers • Supermarkets and institutions (e.g. schools and hospitals) - will provide markets for vegetables
C: Current situation and future scaling up	
Counties where already promoted if any	Vihiga, Busia, Kakamega
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of premium price for quality vegetables discourages farmers and traders to adopt the TIMP
Suggestions for addressing the challenges	Create better markets for well-handled African night shade Train farmers on importance of sorting and grading
Lessons learned in up scaling if any	Farmers are not aware of importance of sorting and grading African night shade
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers and traders are willing to adopt the technology • Avail better markets for different quality of produce • A policy is developed to ensure food safety issues are considered in handling of cowpea vegetables
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost
Estimated returns	Sorting and grading translates to high quality, which fetches higher income.
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women have less access to information on pumpkin fruit packaging • Women have limited access to markets for pumpkins • Women have less access to extension services • Women have limited access to training and education on pumpkin

Gender issues and concerns in development dissemination, adoption and upscaling	• Sorting and Grading of African nightshade is usually done by women increasing their labor. It is easily adoptable after training and many farmers can use the technology since it reduces losses incurred after harvesting and increases income. • Women have less access to information on African nightshade packaging • Women and do most of the work within the African nightshade value chain but the funds are controlled by men hence they have no funds to pay the workers • The management practice are easily applicable hence farmers can easily learn them.
Gender related opportunities	• There is reduced African nightshade post- harvest losses • Creates employment for women and the youth • Increases income for women and the youth • There is increased food security and nutrition for household
VMG issues and concerns in development, dissemination, adoption and upscaling	• Sorting and grading of pumpkins is labor intensive for some VMGs to undertake • VMGs have limited finances to pay labor services due to limited access to credit facilities • VMGs have limited access to agricultural information and extension services hence they might not be aware of the importance of sorting and grading
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Indigenous vegetables collection centres in Busia county
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:
None

2.8.1 TIMP Name	**Zero Energy Brick Cooler**

Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses (?30%) caused by lack of cooling technologies for vegetables
What is it? (TIMP description)	The Zero Energy Brick Cooler consist of a double brick wall filled with sand in between, and a storage chamber. The sand is kept moist with water. The inside chamber is cooled through of the water in the sand. 
Justification	Appropriate cooling reduces postharvest losses and extends shelf-life
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, green grocers, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The sand should be continuously moist. Cooling is more effective in dry and windy environment
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowledge on ZECC
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Kirinyaga
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of starter capital to construct the cooler
Suggestions for addressing the challenges	Avail appropriate financing to construct the cooler Organize farmers into groups to start aggregation centres where the cooler is constructed
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for	• Farmers and traders willingness to adopt the technology • Creation of new markets that offer better price • To form innovation platform for the cooler

development and up scaling	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware ZECC African night shade storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for African nightshade storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the ZECC
Gender related opportunities	• There will be increased shelf life of African nighshade • There will be increased employment opportunities for the youth and women at various nodes of African night shade value chain • There will be stable supply of African nightshade for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of African nightshade • There will be stable supplies of African night shade for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. have used the technology to reduce losses and extend shelf-life, hence the marketing time for the vegetables.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for	Ready for upscaling

upscaling;, 2-requires validation; 3-requires further research**)**	
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

- Optimising the storage conditions and keeping quality of the different vegetables.
- Validate the technology in difference AEZs.
- Research on innovative investment options for farmers and groups.

2.8.1 TIMP Name	**CoolBot™**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of appropriate cooling technologies for vegetables
What is it? (TIMP description)  	It is a low cost postharvest temperature management that improved the shelf life of banana using less power The Coolbot™ is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lesser cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as 4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.
Justification	CoolBot provides inexpensive, effective cooling. Appropriate cooling reduces postharvest losses and extends shelf-life for consumption and marketing. Farmers who can store their produce longer can take advantage of better prices, as market prices can fluctuate dramatically over time.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension workers, women and youth groups, aggregators, traders, household consumers

Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increase postharvest training and direct farmer outreach
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot™ Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooing vegetables. • Limited awareness of the technology by farmers • Inadequate funds to install the Coolbot™
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases tp adopt the CoolBot™
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• CoolBot (US$ 300) • Air conditioner • Insulated room • Monthly electricity costs
Estimated returns	• Increased income. Farmers can store vegetables to sell in the off-season when prices are higher. • Improved cold storage facilities will stabilize fruit and vegetable prices, giving consumers access to nutritious fresh produce all year. • Farmers are better protected to erratic market prices.
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware CoolBotTM African night shade storage due to limited access to agricultural information and technology

	• The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for pumpkin storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the CoolBot™
Gender related opportunities	• There will be increased shelf life of African night shade • There will be increased employment opportunities for the youth and women at various nodes of African night shade value chain • There will be stable supply of African night shade for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of African night shade • There will be stable supplies of African night shade for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories	- Fruit and vegetable farmers in Embu, Kirinyaga, etc. - **Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre** to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guideline for users	CoolBot™ factsheets, brochures and manuals available from KALRO

F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:

- Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the CoolBot™.
- Gross margins of the Coolbot™

2.8.1 TIMP Name	**Wakati™ technology**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of cooling technologies for vegetables
What is it? (TIMP description) 	-Wakati™ is a simple and innovative solution where altered environment in the chamber contributes to shelf life extension -Altered environment is due to: - High relative humidity - Oxidation of ethylene from the storage environment by oxidizing (ozone oxidation) It is a 1m by 1m canvas tent with a solar powered fan t one corner. The fan is placed in a cuplike reservoir. As it rotates, it picks up water into mist droplets, which are distributed in the tent by air currents. When a moisture concentration of 80% is achieved, the surface of the fruit or vegetables remain fresh because there is no loss of water. This low-cost solution helps produce last up to 10 times longer without any refrigeration.
Justification	Appropriate cooling reduces postharvest losses. The technology increases the length of time vegetables can be stored without refrigeration, gives farmers more time to sell. The climate control approach used by Wakati™ is affordable and clean technology.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh vegetables (green grocers). It is appropriate for rural farmers and agro-dealers.

Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The optimal use of Wakati One is outside, in a warm and dry climate. Apart from a small amount of water— around 1L of water a week— it does not require any extra resources. The product does not need a power grid, it works on solar energy.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling vegetables. • Limited awareness of the technology by farmers • Inadequate funds to install the Wakati™
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	Farmers are not aware on use of technology
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the Wakati technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware Wakati™ technology African night shade storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for African night shade storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the Wakati™ technology
Gender related opportunities	• There will be increased shelf life of African night shade

	• There will be increased employment opportunities for the youth and women at various nodes of African night shade value chain • There will be stable supply of African night shade for markets and food in families
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to due to lack of access to credit facilities hence they might not be able to adopt Wakati™ technology • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. So they might not be aware of the Wakati™ technology
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercialization of African night shade • There will be stable supplies of African night shade for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

- Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the Wakati™.
- Gross margins of the Wakati™.

African Nightshade Modified Atmosphere Packaging

2.8.1 TIMP Name	**Modified Atmosphere Packaging of AIVs** (Ziploc® and Xtend® bag packaging)
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to high perishability of the vegetables and limited appropriate packaging materials
What is it? (TIMP description)	Xtend® bags are modified atmosphere bags characterized by high moisture vapor transmission rates. This assures that excess moisture is eliminated, in the event that condensation forms within the bag. The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of African nightshade for between 5-7 days
Justification	The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of African nightshade for between 5-7 days.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh vegetables (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on MAP
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits • Limited awareness of the technology by farmers and traders
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	-
Social, environmental, policy and market conditions	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt MAP technology

necessary for development and up scaling	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development, dissemination adoption and scaling up	• In the target counties, AIVs cultivation is mainly done by women who have limited access to agricultural information and extension services so they might not be aware of the Xtend® bags • Women lose their AIVs due to their limited shelf life and inefficient storage methods and limited knowledge of the new technologies Women have no finances to pay for Xtend® bags due to limited access to credits • The TIMP is easily adoptable after training, providing appropriate credit facilities and availing the Xtend® bags to local agro-dealers; many farmers can use the technology since it reduces losses incurred during storage
Gender related opportunities	• Opportunities for youth in selling Xtend® bags to farmers and traders • The TIMP increases farm income through reduction of postharvest losses and enhancing food safety, hence increased food security and nutrition for households.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs lacks access to information on new technologies and information so they might not be aware of the Xtend® bags • VMGs have no finances due to limited access to credit facilities to purchase the Xtend® bags • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the Xtend® bags means reduced postharvest losses and enhanced food safety for VMGs • The TIMP has the potential of prolonging shelf life of AIVs leading to improving food and nutrition security and a window for increased income. For VMGs • Opportunity for VMGs to engage in marketing of Xtend® bags
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation

G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

5.9 African Nightshade Value Addition

2.8.1 TIMP Name	African nightshade solar drying
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	African nightshade has short shelf life leading to postharvest loss
What is it? (TIMP description)	Solar drying involves drying of Africa nightshade where cabinet solar dryer, greenhouse solar dryer and dehytray are used. 
Justification	Drying of African nightshade improves shelf life and reduces bulkiness which improves marketing.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, consumers, women and youth groups
Approaches used in dissemination	Practical demonstrations, field days
Critical/essential factors for successful promotion	• Create awareness on utilization of African nightshade • Successful in areas with good solar radiation • Local artisans can be trained on fabrication, repair and maintenance • Ensuring sanitary condition when handling vegetables for drying
Partners/stakeholders for scaling up and their roles	Famers- to adopt the technology for usage Artisans - to fabricate the solar dryers Agricultural extension workers- to provide farmers with knowhow on solar drying of vegetables, and utilization of solar dried vegetables
C: Current situation and future scaling up	
Counties where already promoted if any	Isiolo, Kakamega

Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of funds to acquire the solar dryers • Challenges in repair and maintenance
Suggestions for addressing the challenges	• Sensitization of the community about high health and nutrition benefits of solar dried vegetables • Provide loans / capital to farmers groups to acquire the solar dryers • Capacity building of local artisans on repair and maintenance
Lessons learned in up scaling if any	Create awareness on utilization of dried African nightshade
Social, environmental, policy and market conditions necessary for development and up scaling	• Access to better market that offer higher prices • Traders and producers willingness to adopt the technology • Adoption of technology to ensure food safety
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cabinet solar drier costs approximately KES 20,000/-
Estimated returns	Increased income, nutrition Reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	• African nightshade cultivation is mainly done by women who have limited access to agricultural information and extension services so they might not be aware of African nightshade solar dryer • Women lack finances due to limited credit facilities so they might not be able to purchase African nightshade solar dryer • Most decisions relating to purchasing of farm equipment are made by men who have no interest in African nightshade value chain hence they might not purchase the dryer
Gender related opportunities	• The TIMP increases farm income through reduction of postharvest losses • Adoption of African nightshade solar dryer enhances food security and nutrition for households
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs lacks access to information on new technologies and information so they might not be aware of African nightshade solar dryer • VMGs have no finances due to limited access to credit facilities to purchase African nightshade solar dryer • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the African nightshade solar dryer means reduced postharvest losses and enhanced food safety for VMGs

	• The TIMP has the potential of prolonging shelf life of African nightshade leading to improving food and nutrition security and a window for increased income for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guideline for users	Solar drying guidelines and brochures from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation.
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Machakos Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Research Gaps

1. Limited information on success stories of AIVs.
2. Cultural issues in participation in some AIVs species value chains
3. Low information on profitability of AIVs in the project areas

5.10 Farming Business and Marketing of African Night Shade, Amaranth, Spider Plant, Slender Leaf, Cowpea, Jute Mallow and Pumpkine

TIMP Name	**Transformative Model of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Most of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers have small production units with limited use of improved inputs. This leads to low African night shade, Amaranth, Spider plant, Slender leaf,

	Cowpea, Jute mallow and Pumpkine productivity. Low productivity leads to poor market access, .
What is it? (TIMP description)	An approach to transform smallholder farmers from low improved inputs to high and therefore build market linkages. At the fully commercial level, inputs are accessed from the markets and outputs solely for the markets.
Justification	Market failures or missing markets of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine have led to disorganization in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Due to the disorganization in production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, smallholder farmers fail to access markets or have limited market linkages. Therefore, this model aims at linking farmers to markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, Universities, policy makers
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of traders and other upstream actors • Acceptance of smallholder farmers to form production organizations • Investments in the production of quality tradable volumes • Acceptance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties by consumers • Adaptability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties • Prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Availability of storage infrastructure and transport

Partners/stakeholders for scaling up and their roles	• Farmers – Formation of production groups, investments in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local traders and exporters) – Support in input services and providing markets for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties • Group dynamics • Lack of seeds • Weak or non-existent stakeholder innovation platforms • Fluctuations in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices • Levels of production constraints • Level of policy support • Poor and week linkage
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production farmer groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming. Improved productivity • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties – Use

	of promotion channels for instance meetings, stakeholder forums, media, demonstrations and field days • Group dynamics – Capacity building of the groups on group dynamics and management • Limited supply of demanded seed varieties – Engagement seed companies. • Capacity building of farmers on seed production • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Low and fluctuating African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices - Value addition, organized marketing channels, producer organizations, capacity building on the reduction of production costs, capacity building on farming as a business • Levels of production constraints – improving credit accessibility, enhancing adoption of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine TIMPs • Level of policy support – Lobbying for the County government support in policy formulations
Lessons learned in up scaling if any	• There is need to have an all inclusive enhance value addition in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to increase profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability by the farmers, group dynamics, cultures to have value added products • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), • infrastructure, investment environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000

Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Different acceptance characteristics by youth, females and males. Gender roles in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. Availability of technologies for pre-harvesting, harvesting and post-harvesting • Adoption and scaling – Different acceptance characteristics, Gender inclusion in the formation of producer organizations.
Gender related opportunities	• Production opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Emerging mechanization in the value chain • Generation of income by youth female and male
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited involvement of VMGs in the market linking models • Adoption and scaling up - Limited access to seed and information on production techniques
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generation using farmer-market linking arrangements • Access to inputs and markets through linkages and producer organization
E: Case studies/profiles of success stories	
Success stories from previous similar projects	High yielding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine hybrid seed bought by the county government of Marsabit and other counties
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294

Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Evaluating efficiency of the farmer-market linking and business models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Building a Business Plan for African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Unplanned and traditional production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine leads to lack of production targets, losses and market failure, leading to low productivity.
What is it? (TIMP description)	A business plan is a document guides the operations in a business. The document contains details susch as introduction, business organization, product, marketing strategy, risks, business operation plan, marketing costs, Income streams, profit and loss analysis and financial requirements
Justification	A Business without a plan cannot identify its strenths, weaknesses, opportunities and threats. Guided by a business plan, farmers will not analyse opportunities, explore options, select the best option, detailed planning and implementation. There are many opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, processing and marketing. However, the achievement of the best opportunity would depend on the analysis of strength, weaknesses and threats.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, NGOs, Extension agents, policy makers and implementers
Approaches to be used in dissemination	Trainings, factsheets, manuals

Critical/essential factors for successful promotion	• Education levels of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farmers and other actors • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Supporting policies and regulations
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding opportunities • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders, processors and exporters) – Demanding opportunities • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub

	• Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Sensitization of stakeholders the challenges • Level of policy support – support in extension services
Lessons learned in up scaling if any	Need to address the challenges in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to enhance benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming in the climate change situations • Environmental conditions – Use of opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Marketing opportunities for youth, men and females • Adoption and scaling – Harmonizing opportunities
Gender related opportunities	Production and marketing opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited opportunities • Adoption and scaling up – Comparisons of opportunities and weaknesses at the level of VMGs
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generating opportunities for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Utilization of Amaranth in Kitui, Machakos and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides are available

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the SWOT matrix
- Efficiency in identifying the opportunities
- Performance of the opportunities

TIMP Name	**Profitability analysis**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The problem of failure of profitability analysis is common among the smallholder farmers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. This leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise in terms of low productivity and income
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain, leading to low productivity
Justification	Profitability analysis reviews the management success and sustainability of the Finger millet business. It indicates areas of adjustment .
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, policy makers

Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	• Production programme • Availability of data on quantities of inputs requirements, costs, outputs and value
Partners/stakeholders for scaling up and their roles	• Farmers – Defining production programme • County extension staff - Capacity building • NGOs – Capacity building • Research – Cost-benefit analysis
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and Marketing • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Level of policy support – support in extension services
Lessons learned in up scaling if any	Majority of farmers do not keep records

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Environmental conditions – Opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Poor record keeping, low income, low engagement in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Adoption and scaling – Involvement of youth, females and males
Gender related opportunities	Implementation of production and marketing opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – African night shade, • Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production Programmes for VMGs • Adoption and scaling up – Levels of profitability
VMG related opportunities	• Production opportunities – African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production programmes • Profitable opportunities like production, processing
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100

	Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the budgets
- Profitable opportunities
- Effects of record keeping

TIMP Name	**Marketing Innovation model for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine Production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	As farmers produce and market African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, they fail to follow business principles including marketing strategies in farm operations and farm activities geared toward making a profit
What is it? (TIMP description)	Production and marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit. An entrepreneur farmer undertakes innovations and finances business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of finger millet, the market outlook will be narrow. Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles in farming leads to unsuccessful.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers., traders
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT

Critical/essential factors for successful promotion	• Organization of farmers • Availability of innovations • Achievement of profit • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	• Farmers – Acceptability of innovations • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders, processors, and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Small-scale farming • Availability of information • Profitability in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farming • Levels of policy support
Suggestions for addressing the challenges	• Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional methods • Environmental conditions – Use of pesticides and disposal • Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the innovations adoption

	• Adoption and scaling – Differentiated innovations for instance spraying by females is difficult. Youth is normally engaged
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the innovations adoption • Adoption and scaling up – Capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs leading to improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Efficacy and suitability of various chemicals
- Sustainability based on market prices
- Innovations for the increased productivity

TIMP Name	Collective marketing
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Low productive leading to lack of bargaining power and volumes for sale
What is it? (TIMP description)	A marketing or producer organizations formed by farmers
Justification	Poor farmers in many remote areas do not understand how the market works or why prices fluctuate; they have little or no information on market conditions, prices and quality of goods; they are not organized collectively; and they have no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market. Difficult market access restricts opportunities for income generation. Farmer organization provides relevant data to help solve marketing challenges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Barazas, Trainings, Factsheets, Manuals, Field days, ICT, Radio.
Critical/essential factors for successful promotion	• Organization of farmers • Availability of facilitators • Availability of many traders • Production volume and quality • Trust • Innovativeness
Partners/stakeholders for scaling up and their roles	• Farmers – Organization of groups • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators • County government – Policy support
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Availability of information

	• Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organization • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming, improved productivity • Availability of information – Capacity building of producer groups • Policy support – Engagement with the county government
Lessons learned in up scaling if any	Reduction of transaction costs leading to increased profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented • Environmental conditions – Depleted soil nutrients due over-use of cultivated land and pollution due to use of pesticides • Policy conditions – Available policy support
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the marketing organization committee • Adoption and scaling – Inclusion of youth, males and females in capacity building
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the formation of marketing organization • Adoption and scaling up – Consideration of VMGs during capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of marketing organization
- Sustainability of the management of the organization
- Equity distribution in sales and income

TIMP Name	**Contracted production**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Markets failure in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves private companies extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.
Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the

	farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension, research institutions, farmer cooperative societies
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Production volume • Enforcement and bidding contract farming
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff - Capacity building, signing contract • NGOs – Capacity building • Private sector (local traders and exporters) – Contract party and beneficiaries • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Lack of information by part of the producers • Level of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters

	• Small-scale farming – Increase volume through increase in productivity • Lack of information by part of the producers – Capacity building • Level of policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming • Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management • Policy conditions– Policy in formulation and enforcement • Market conditions – volume, place, price, promotion, traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in signing of the contract • Adoption and scaling – Equity distribution of income based on contract farming
Gender related opportunities	Market access, increased income, improved livelihood
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building • VMGs • Adoption and scaling up – Participation in signing contract farming
VMG related opportunities	Market access, increased income, improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100

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Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of contracted farming in terms of productivity, sales and profit
- Equity distribution
- Improvement in skill and information delivery

TIMP Name	Digital marketing
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Poor market access due to constraints in marketing channels, skills and market information leading to low productivity
What is it? (TIMP description)	Internet marketing refers to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and profitability analysis • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of african night shade, amaranth, spider plant, slender leaf, cowpea, jute mallow and pumpkine • Research institutions – Capacity building
C: Current situation and future scaling up	

Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	• Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – low levels of adoption of information technology • Environmental conditions– improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000

Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Capacity building in digital skills for the youth, men and females • Adoption and scaling – Capacity building on benefits of digital marketing skills for the youth, men and females
Gender related opportunities	Improved accessibility of information duel to availability of mobile phones by youth, males and females
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building on digital skills • Adoption and scaling up – Capacity building on benefits of digital marketing skills for the VMGs
VMG related opportunities	Improved accessibility of information duel to availability of mobile phones by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Levels of digital skills by farmers
- Performance of the internet marketing in terms of productivity, sales and profitability

TIMP Name	**Market research**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	

Problem addressed	Farmers' lack of market information on outlets and prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
What is it? (TIMP description)	A approach by farmers to gather market information
Justification	The rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore participatory market research will assist farmer to gain knowledge on the structure and performance of markets leading to higher profit.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media, ICT
Critical/essential factors for successful promotion	• Availability of County policies • Willingness of farmers • Availability of targeted markets • Access to markets
Partners/stakeholders for scaling up and their roles	• Farmers – participants in market research • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine -byproducts market outlets. • Lack of skills in the use of communication technologies • Group dynamics • Policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Organization of producer groups for cooperate marketing.

	• Small-scale farming – Increase hectarage under African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, improving productivity and aggregation of produce to achieve large volume for the market • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Capacity building on sources of information. • Group dynamics – Capacity building • Policy support – Support in extension services
Lessons learned in up scaling if any	Improved marketing strategies
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Level of education of the community • Environmental conditions – Farmers are in different geographical localities • Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – Existing demand
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in the participatory market research • Adoption and scaling – Capacity building youth, males and females
Gender related opportunities	Increased production and marketing opportunities by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the participatory market research • Adoption and scaling up – Capacity build VMGs
VMG related opportunities	Increased production and marketing opportunities for the VMGs leading to higher income
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Barazas, training factsheets, manuals and power point slides

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of participatory market research process
- Production and marketing efficiency in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine due to the participatory market research process
- Equity distribution in income and change in livelihood

5.11 Agricultural Policy Options

TIMP Name	**Advocacy in farmers' participation in the National Agricultural Policy development and implementation**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provide objectives
What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provides objectives.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter,email), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine-based policies
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Value Chain: African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • Standards: Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, wherein many farmers abandoned African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. These weak

	organizations provide few services to farmers while providing limited bargaining power. • Financial Incentives: The government provides only limited support to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs).
	Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.
Suggestions for addressing the challenges	• Value Chain: Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors. • Standards: Existing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training. • Aggregation: Partnerships between farmer cooperatives and African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs. • Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute

	mallow and Pumpkine payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine where there is no value chain • Environmental conditions – Use of pesticides • Policy conditions – Lacking specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Supporting youth, females and males in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling – Supporting youth, females and males in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
Gender related opportunities	• Providing incentives to youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling up - Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine

VMG related opportunities	• Providing incentives to VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Participation in the County Integrated Development Planning**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Poor performance of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine sub-sector in Marsabit county leading to low African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production/ productivity and income

What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Finger millet production, marketing and processing are considered. ..
Justification	Agriculture is the main economic activity in Marsabit County. The county is Kenya's largest producer of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, producing approximately 40%. This has significant implications on income generation, food security and poverty reduction efforts in the county. Therefore African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine is a major cash crop considered in the Marsabit county integrated development plan (CIDP). Smallholder farmers' failure to participate during the planning of the County Integrated Development would lead to omission in the development funding and implementation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders Universities
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming

	• Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males

VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The project offers support to all categories of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers including the VMGs
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Ready for up scaling
Lead organization and scientists	
Partner organizations	

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**
Category (i.e. technology, innovation or management practice)	**Management practice**

A: Description of the technology, innovation or management practice	
Problem addressed	The existing policy instruments do not centralize the smallholder farmers' issues in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Therefore, weak policy instruments lead to market failure for both inputs and outputs
What is it? (TIMP description)	Agricultural policy is implemented through instruments which are the intervention points. Therefore, the policy instruments are the means to achieve policy objectives
Justification	Without policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, farmers will remain without support in the agro-enterprise and market development. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability may lack centralization of the smallholder farmers agency and voices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders • Universities - sensitization
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming

	• Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males

VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Nutritional project implemented in Machakos, Kitui and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy cycle**

Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy leading to low productivity due to low adoption of quality inputs and poor marketing channels
What is it? (TIMP description)	Policy cycle involves problem definition or concerns, formulation, implementation and evaluation components
Justification	Policy cycle is used in the formulation and implementation of agricultural policies for the agriculture and rural development. Due to lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy, policy cycle can be used in the formulation and implementation and evaluation of outcome. African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain has specific policy concerns which can be identified at the stage of problem definition in the policy cycle. The issues are addressed at the implementation stage. As the implementation goes on, there is need for an evaluation at the evaluation stage to determine the success of the policy. The cycle completes by the establishing of the failure in to achievement the objectives or goals of the development agenda.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Public participation meetings
Critical/essential factors for successful promotion	• Availability of stakeholders • African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy concerns • Level of understanding of stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • County extension staff - sensitization of stakeholders
	• NGOs – sensitization of stakeholders • Private sector (local traders and exporters) – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain

	• Research institutions – sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of spearheading in the policy formulation • Lack of organized forums • Inadequate information to stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain
Suggestions for addressing the challenges	• Lack of spearheading in the policy formulation – the agricultural department in the county should take the initiative to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is in place • Lack of organized forums - formation of stakeholder forums consisting of well-informed participants. • Inadequate information to stakeholders – sensitization of stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain – active participation by the actors in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain.
Lessons learned in up scaling if any	For the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry to progress, there is need for a African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – social inclusion • Environmental conditions – environmental conservation strategies to be highlighted in the policy • Policy conditions – to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is formulated and implemented • Market conditions – within the policy framework
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting youth, females and males in the production • and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – The policy should facilitate the benefits to vulnerable and marginalized groups • Adoption and scaling up - The policy should facilitate the benefits to vulnerable and marginalized groups
VMG related opportunities	• People with Disability will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income of VMGs • Increased employment of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos

	cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers 3 Farmer accessibility to production inputs.
- Sustainability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry

5.12 Good Agricultural Practices and Food Safety Management System African Nightshade

TIMPs name	**Good Agricultural Practices (GAP**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Detection of food contaminants in both fresh produce, including AIV's, has been rampant. This results in declining food safety and quality, therefore frustrating sustainable farming of these crops for both food and income generation. Most markets continue to impose more stringent measures (to ensure the safety of consumers) for those wishing to access the said markets. These contaminants also impact negatively on the environment, worker safety and health; and consequently making it difficult to implement traceability, as most producers do not give accurate information on inputs and processes used during production, to avoid commercial losses and even prosecution
What is it? (TIMP description)	It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards (It is not about a specific crop production, but the process through which production takes). The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. Commercialization of AIV's on the domestic and future export level highly depends on compliance to these market standards
Justification	There is need to arrest the rampant detection of food

	contaminants in AIV's. Good Agricultural Practice(s) (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture [by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM)] to continuously improve farming systems. GAP is of utmost importance in protecting consumer health by ensuring safety throughout the food chain. It needs to be enforced and transparent, not only from the table but also upstream to include suppliers (e.g. quality of fertilizers and plant protection products) and all the value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support from government particularly the enforcement of KS1758 (a domestic scope standard that has been passed after undergoing public participation stage).
Partners/stakeholders for scaling up and their roles	Producer organizations (FPEAK, FPC, KFC, AGAK etc), NGO's, MOALID, Private extension providers, CoG, and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	Already promoted in Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasingishu, Nakuru, Kericho, Bomet and other horticultural hot spots
Counties where TIMP will be up scaled	All counties in Kenya particularly where AIV's is grown
Challenges in dissemination	• Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Difficult to put monetary gains figures as most involves social and welfare issues in addition than markets lost due to non-

	compliance
Estimated returns	Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have less access to factors of production like land and credit • In most households, it is the men who make decision on what to do and how it is done ▪ Women may not have time and mobility to attend trainings and other extension activities far from home or held at times when they are performing other domestic roles ▪ Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles ▪ Women might not be aware of GAPs due to their low level of education and the social economic status ▪ There is need for all the stakeholders to be sensitized in GAPs to achieve good profits from their AIV's products
Gender related opportunities	• Agro-enterprise development by youth, females and males based on GAPs • Increased income due to improved income as a result of using GAPs by the youth, females and males
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to GAPs as they are not given chances to participate in agricultural trainings and workshops • VMGs have less access to farmer organization • VMGs have less access to farm implements VMGs have limited access credit to purchase the required GAPs • VMGs have limited access to training on GAPs and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination of GAPs • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Agro-enterprise development by VMGs based on GAPs • Increased income due to improved yield because of using GAPs, market access for the VMGs • Increased employment for VMGs and improved food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Small, holders in groups in the counties of Kirinyaga, Nyeri, Meru, Nakuru and other counties have been able to produce and export produce from horticultural crops that are certified after adopting and complying with GAP's.
Application guidelines for users	• Global GAP Version 6 (Code Ref: IFA V5.2_Feb19; English Version Versionn /Edition Update Register Page: 45 of 45) - https://www.globalgap.org/.content/.galleries/documents • KALRO-USAID Training And Extension Manual On Good Agricultural Practices (Gap) - Nov. 2017
F: Status of TIMP readiness (1.	Ready for up scaling

Ready for upselling; 2. Requires validation; 3. Requires further research	
G: Contacts	
Contacts	• Director, KALRO Seed –Thika; info.ptc@kalro.org • Centre Directors; KALRO Kandara, • KALRO NSRC; • Director General KALRO
Lead organization and scientists	KALRO: Nyaga A., Ndungu J., Gatambia E., Kambo C., Kuria, S Musyoki R. Wasilwa, L., Kirigua, V., Muriuki SJN.
Partner organizations and their roles	MoALF&I, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's, Universities

TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for AIV's Value Chain in Kenya**
Category (i.e. technology, Innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The presence of chemical, biological and physical hazards within the AIV's value chain in Kenya have a direct effect on consumer's health. There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in AIV's value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the AIV's supply from biological, chemical and physical hazards into the hands of food management systems. The system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls.
Justification	There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties.

	The biological contaminations previously reported on this value chain include presence of Escherichia coli (E. coli), Salmonella spp., Aspergillus flavus and Aspergillus parasiticus. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects. There is need to put in place risk analysis and hazard monitoring and management system to ensure that food contaminants are kept at bay along the AIV's value chain. Presence of these contaminants not only poses serious risks to human health and trade. Such tools are used globally and even adapted by Codex Alimentarius as a global acceptable FSMS. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range as required. Parameters will be quantified for production, harvesting, processing, distribution and value addition
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV's value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• Training of stakeholders on GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP) • AIV's innovation platforms • FFBS sessions • Through common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).
Critical/essential factors for successful promotion	• Formation of "experts" team composed of HACCP specialists, food scientists, microbiologists, representative of the AIV's (and other similar crops) value chain players, public health officers, and a quality control and safety specialists from the competent authorities to guide the process • Local and National governments support
Partners/stakeholders for scaling up and their respective roles.	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players • Farmers/farmer groups • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • National competent authorities • Analytical testing services • Processors and local traders

C: Current situation and future scaling up	
Counties where already promoted if any	• Not promoted in any county of Kenya
Counties where TIMPs will be up scaled	• All counties growing and consuming AIV's in Kenya.
Challenges in development and dissemination	• Inadequate funds to reach value chain actors • New concept not very well known among the primary stakeholders and market outlets
Suggestions for addressing the challenges	• Funding of dissemination platforms • Training of all stakeholders on food safety
Lessons learned in up scaling, if any	• None since scaling up has not been done
Social, environmental, policy and market conditions necessary for development and up-scaling	• AIV's being observed by stakeholders as a food and commercial crop that requires protection from contamination • Use of less toxic crop protection methods in handling crop health issues • Establishment of practical and acceptable food handling protocols at both county and National levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth might not be aware of the existing hazards, their preventive measures and control • Women and youth might to be aware of the impact identified hazards could have to their health • In harvesting and processing AIV's to meet the acceptable national standards, women and youth play critical roles. • Therefore, there is need to build the capacity of women and youth in the identifications of food safety hazards/risks and the control measures along AIV's value chain • Women and youth lack finances
Gender related opportunities	Opportunities exist for women and youth in the marketing and use of AIV's and it's by products as an entrepreneurship.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • VMGs have limited participation in decision making at community and County level • Require strategies that target the VMG during scaling up of the AIV's value chain.
VMG related opportunities	• Identification of critical limits to be defined • Control measures to be identified • Criteria for compliance already clearly defined for adoption
○ **E: Case studies/profiles of success stories**	

Success stories	N/A
Application guidelines for users	• HACCP general guidelines - https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/ • General principles of food hygiene - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%25253A%25252F%25252Fworkspace.fao.org
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling;
○ **G: Contacts**	
Contacts	The Institute Director, FCRI Njoro; Email director.fcrinjoro@kalro.org The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seeds, E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	2. 1. Mr. John N. Ndung'u, FCRI - KALRO Njoro 3. Antony Nyaga, KALRO Seeds Thika 4. Dr. Francis Wayua, KALRO Kakamega 5. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 6. Mrs. Violet Kirigua, KALRO Headquarters 7. Beatrice Wanjiku, KALRO Njoro
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, KEBS, County governments, NGO's and Universities.

6.0 Jutemallow Technologies and Innovative Management Practices

6.1 Improved Jutemallow KATMurenda 1

TIMPS name	KATMrenda 1
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low yields
What is it? (TIMP description)	High yielding - 10 t/ha^{-1} High consumer acceptability – very testy Affected by few pests and disease It is late maturing (6 months) hence wide harvesting interval

	Does not require much attention. Highly nutritious variety which contains dietary fiber, calcium, protein, iron, potassium, copper, magnesium, zinc Vitamin C, Vitamin E, Vitamin B1(Thiamine), Vitamin B2 (Riboflavin) and Beta carotene.
Justification	Jute mallow is rich in vitamins, minerals, proteins, fiber and essential amino acids and is an important leafy vegetable that blends well with indigenous vegetables to improve texture and test.. Available landraces are however low yielding due to various environmental factors such as erosion, desertification and intensive cultivation with poor soil management. Jute mallow can be grown throughout the year under irrigation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, farmer groups, traders and seed companies
Approaches used in dissemination	Training materials, farmer field days, shows and exhibitions, demonstrations, farmer trainings
Critical/essential factors for successful promotion	It is an emerging vegetable and is used to blend other vegetables. Reliable market outlets as such as supermarkets, hotels and hospitals. Creating awareness on the nutritive benefits of jute mallow is essential
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	KakMega
Challenges in development and dissemination	Inadequate funding for technology development and dissemination, Inadequate/lack of information on production knowhow.
Suggestions for addressing the challenges	More funding for research and extension services
Lessons learned in up scaling, if any	- Farm yard manure key in production of jute mallow. - Consumer taste of jute mallow to exotic
Social, environmental, policy and market conditions necessary for development and up-scaling	- Up scaling of developed technologies (Varieties) and agronomic packages - Put in place an efficient seed system - More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens.

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Production of jute mallow is economically viable although not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to productive resources such as land, farm equipments and credit facilities as compared to men • Women have limited access to education, training and extension services than men hence might not have information on improved Jute Mallow Kat Mrenda 1 1 variety • Women have low production of Jute Mallow as they plant poor quality seeds as they do not have finances to purchase improved seeds of the new varieties • Women have limited access to markets such as agro-vets where they can buy new seeds due to limited mobility associated with their domestic roles
Gender related opportunities	• Improved Jute mallow Kat Mrenda 1 variety • is a fast growing hence has the potential of providing stable supply of vegetables to the markets hence increased income for women • Improved Jute Mallow KAT Mrenda 1 variety has the potential of providing food security and nutrition for women and youth • Improved Jute Mallow KAT Mrenda 1 variety is high yielding hence has the potential of providing employment for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to training and extension services they might not have access to new information relating to improved Jute Mallow KAT Mrenda 1 variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure hence they might not have access to Improved Jute Mallo KAT Mrenda 1 seeds • The VMGs might not be able to purchase Improved Jute Mallow KAT Mrenda 1 variety seeds as they do not have finances due to limited access to credit facilities • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• If improved Jute Mallow KAT Mrenda 1 variety o is adopted there will be high production of Jute mallow leading to employment for VMGs • There will also be increased incomes for VMGs • There will be increased food security and nutrition for

	VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Require validation
G: Contacts	
Contacts	Centre Director, KALRO Katuamni, P. O. Box 340-90100, Machakos, Kenya
Lead organization and scientists	KALRO; C. Ndinya, M. Odendo
Partner organizations	Ampath Moi Referral Hospital, University of Eldoret, Chuka University, World Vegetable Centre

GAPs
Required:
Identification of superior jute mallow varieties
A reliable seed system

6.2 AIVs Seed systems: Jute mallow

TIMP Name	**Formal Jute mallow seed system**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Jute mallow is mainly due to low availability of diverse high-quality and locally adapted Jute mallow seed varieties. About 80% of Jute mallow seed is from informal seed system with no quality assurance.
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The formal Jute mallow seed system is characterized by a well-regulated and organized set of activities, from breeding to delivering certified seeds of known and registered varieties to farmers and other stakeholders. It ensures continuous production, processing, supply and distribution of quality Jute mallow seeds to farmers through organized marketing channels.
Justification	The formal seed system comprises registered seed producers or seed companies and the certification process, which is usually controlled by a public regulatory body (KEPHIS), thus assuring high seed quality for improved yield. Supply of good quality

	seeds strengthens the trust of farmers in seed producers and sellers and encourages variety adoption.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, traders • Research organizations and universities, Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs) •
Approaches used in dissemination	• Training • Field days, exhibitions, seed fairs, demonstrations, agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche • Application of Participatory methods to promote the seed model and varieties • Offering seed at affordable prices • Organized Jute mallow product market • Strong Partnership of actors
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed, seed multiplication and technical backstopping • JKUAT: Breeders' seed, seed multiplication and technical backstopping • Seed companies: Seed multiplication, distribution and technical backstopping. • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs):: Seed multiplication and dissemination • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume Jute mallow products to create demand for Jute mallow seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed • World Vegetable Centre: Funding and technical backstopping
• **C: Current situation and future scaling up**	

Counties where already promoted. if any	• Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	• Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released. • Low availability of basic seed for multiplication of certified seed • Low demand for Jute mallow seeds: Most farmers recycle their own seed and cost of seed is high. • Poor quality/fake seed of Jute mallow from seed companies/agro dealers. • Most farmers not aware of potential of seed from formal seed systems.
Suggestions for addressing the challenges	• Lobbying for funding of Jute mallow research and multiplication of basic seed. • Multiplication of seed with farmer preferred traits and offered at affordable prices • KEPHIS to improve seed inspection in agro-dealer networks to ensure quality of Jute mallow seed and reduce sale of fake seed • Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.
Lessons learned in up scaling, if any	• Adoption of Jute mallow seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt. • Favourable agro-ecological conditions. • Availability of adequate market for Jute mallow seed and products. • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Jute mallow production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Jute mallow is considered women's crop. and requires low external resources for production. Most labour for Jute mallow production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Jute mallow as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Jute mallow productivity for food and nutrition security and income generation. In particular, production of Jute mallow is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Jute mallow. Youth could also benefit through application of ICT networking for marketing of Jute mallow. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter Jute mallows commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure

VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Jute mallow. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. • Under the two projects, farmers in Nandi and Kakamega counties produced seed of AIVs species (Jute mallow, Jute mallow, nightshade, Jute mallow, slender leaf, jute mallow) using both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels • National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems under KALRO SEED. Farmer groups in Vihiga county formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and sell in Nairobi
Application guidelines for users	• Leaflets on Jute mallow seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)—	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

3. Narrow range of varieties with market preferred traits
4. Low demand for AIVs seed from formal seed system

TIMP Name	Informal Jute mallow seed system

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Jute mallow is mainly due to low availability of diverse high-quality and locally adapted Jute mallow seed varieties. About 80% of Jute mallow farmers grow seed from informal seed system with no quality assurance. Farmers have limited access to seed from formal seed sector due to high cost of the seed and limited varieties with desired traits
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The informal Jute mallow seed system entails seed selection, treatment, storage, multiplication, and distribution. The informal Jute mallow seed system is outside the control of government agencies, with no external seed quality control. This system includes farmer-saved seed, gifts, barter, exchange and seed purchasing from local markets.
Justification	Available Jute mallow seeds are predominantly Open-Pollinated Varieties (OPVs). The private sector has low incentive to produce the OPVs because farmers can recycle the varieties for several seasons without marked yield loss. The informal seed sector is justified for accessing Jute mallow seed due to low availability of improved varieties with desired traits and high cost of seed from formal sector.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, Traders, • Research organizations and universities, • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs)
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs Demonstrations, Agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche. • Application of Participatory methods to promote the seed model and varieties • Offering of seed at affordable prices • Organized Jute mallow product market

	• Strong partnership of actors
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume Jute mallow products to create demand for Jute mallow seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released • Low availability of basic seed for multiplication of certified seed • Quality of seed not assured • Low demand for Jute mallow seeds: Most farmers recycle their own seed and cost of seed is high. • .
Suggestions for addressing the challenges	• Lobbing for funding of Jute mallow research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices • Capacity building of farmers and farmer groups on high quality Jute mallow seed production • Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.
Lessons learned in up scaling, if any	• Adoption of Jute mallow seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Strong partnership linkages are important in seed technology dissemination and adoption

	• Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt • Favourable agro-ecological conditions • Availability of adequate market for Jute mallow seed and products • Favorable policies and regulations to support informal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Jute mallow production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Jute mallow is considered women's crop. and requires low external resources for production. Most labour for Jute mallow production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Jute mallow as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Jute mallow productivity for food and nutrition security and income generation. In particular, production of Jute mallow is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Jute mallow. Youth could also benefit through application of ICT networking for marketing of Jute mallow. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter Jute mallows commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets

VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Jute mallow. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• No known case of successful informal Jute mallow seed system •
Application guidelines for users	• Leaflets on Jute mallow seed varieties available at KALRO-Kakamega.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

TIMP Name	**Semi-Informal Jute mallow seed production system**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Jute mallow is mainly due to low availability and limited access to diverse "high-quality locally adapted AIVs seed varieties to farmers and other stakeholders. In addition, farmers have limited knowledge and skills in seed selection, treatment, storage, multiplication, and distribution. Farmers' demand for seed from formal sectors is low due to several reasons including low availability, high cost and lack varieties with desired traits.

What is it? (TIMP description)	The semi-formal seed system (termed community-based) is at the interface of formal and informal seed systems. A community-based seed production system involves individual farmers or farmer groups or cooperatives producing quality seed of farmers and improved varieties (at testing and sensitization stage) using the formal seed production guidelines.
Justification	High quality seed is produced by a seed producer subject to quality control and complying with the minimum standards for the crop species concerned. The requirements for Semi-informal seed are less stringent than those of certified seeds while guaranteeing satisfactory seed quality. The cost of such seed is more farmer-friendly and varieties are produced according to farmer demands.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups • Seed companies • Agro-dealers, traders, • Research organizations and universities • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs) •
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs, Demonstrations, Agricultural shows , • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market nicheApplication of Participatory methods to promote the seed model and varieties • Offering of seed at affordable prices • Organized Jute mallow product market • Strong Partnership of actor
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed

	• Individual consumers: consume Jute mallow products to create demand for Jute mallow seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released • Low availability of basic seed for multiplication of certified seed • Low demand for Jute mallow seeds: Most farmers recycle their own seed and cost of seed is high. • Most farmers aware of potential of seed from semi-formal seed systems
Suggestions for addressing the challenges	• Lobbying for funding of Jute mallow research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices. • Sensitize farmers and other stakeholders on benefits of AIVs seed from semi-formal seed system.
Lessons learned in up scaling, if any	• Adoption of Jute mallow seeds from informal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption. • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption. • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt • Favourable agro-ecological conditions • Availability of adequate market for Jute mallow seed and products • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Jute mallow production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Jute mallow is considered women's crop. and requires low external resources for production. Most labour for Jute mallow production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Jute mallow as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Jute mallow productivity for food and nutrition security and income generation. In particular, production of Jute mallow is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Jute mallow. Youth could also benefit through application of ICT networking for marketing of Jute mallow. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter Jute mallows commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed.

	• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Jute mallow. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. Under the two projects farmers in Nandi and Kakamega counties produced seed of AIVs species (Jute mallow, Jute mallow, nightshade, Jute mallow, slender leaf, jute mallow) in both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels • National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems. Farmer groups in Vihiga county formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and send to Nairobi
Application guidelines for users	• Leaflets on Jute mallow seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

6.3 Agronomic management practices Jute Mallow

TIMPS name	**Variety selection, Seed acquisition or Own Seed Selection, Planting, Weeding, Thinning, Fertilizer Application, Pest and Disease Management, Harvesting, Storage and.**

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Low farm yields • Poor management and agronomic practices at farm level
What is it? (TIMP description)	-This includes :- **seed acquisition:** - Certified seed or training on proper own selection
	Land preparation - Ploughing - Harrowing is necessary - Preparation of a fine seedbed. **Soil fertility Management** Farm yard manure application at the rate of 5 ton/ha-^{1} **Planting and seed rate** - Early planting at onset of rains - Depth 5 cm. - Seed rate 2-3 Kg/acre - Mix jute mallow seeds with dry sand or soil at the rate of 1 part seed: 3-5 parts dry soil/sand **Spacing** Make drills at a spacing of 45-60 cm x 10-20 cm apart, thinly sow the seeds in the drills and cover lightly with soil **Weeding:** - Keep the crop weed free until it is well established - Weeding is necessary after its establishment. **Thinning:** - Subsequent thinning should be done 2-3 times until the leaving one plant at an intra-row spacing of 15-20 cm apart **Harvesting:** - Leaf harvesting commences at four weeks after germination, then once every 2 weeks for 3-4 months - Harvesting may done at once when crop attains a height 20-30 cm or at 4-6 weeks after germination.
Gender issues and concerns in development, dissemination , Gender adoption and scaling up	Jute Mallow plant stakeholder might not have adequate knowledge of the existing good agronomic practice especially women since they have less access to agricultural information and extension services Women and youth have the perception that good agronomic practices are oppressive, time consuming and labour intensive as they do not see the working for their good Most small-scale production systems are centered women and hence it's them who suffer from the detriments of poor

	processes; for example, improper site selection , preparation sowing, thinning and harvesting Women farmers have no finances to pay hired labour so as to ensure that good agronomic practices are embraced due to limited access to credit facilities Women are the ones who are usually engaged in spider plant production and they are usually left out when important agricultural workshops are held due to the social status in the community
Gender related opportunities	Increased productivity will benefit the household Adopting agronomic practices will lead to increased production of the spider plant hence there will be creation of employment for women and youth Adopting appropriate agronomic practices will lead to improved food security and nutrition for house holds Adopting appropriate agronomic practices will lead to increased income for women and youth
VMG issues and concerns in development, Dissemination, adoption and scaling up	• Some of the agronomic practices are complicated for VMGs to undertake such as land preparation especially for those who are abled differently • VMGs have no finances due to limited credits to hire labour and also to purchase required facilities required while applying appropriate agronomic practices • VMGs might not be able to get information relating to appropriate agronomic practices due to limited access to agricultural information and extension services • Due to their social status VMGs are often excluded from participating in workshops and in dissemination meetings relating to where appropriate agronomic practices are discussed • Most of the VMGs might not get adequate information relating to the agronomic practices due to unfriendly dissemination methods and low illiteracy of the VMGS
VMG related opportunities	. • Increased income due to improved production as a result of using appropriate agronomic practices by VMGs • There is potential of stable income and livelihoods for the VMGs • Application of appropriate agronomic practices will lead to improved food security and nutrition for VMGs

6.4 Soil Fertility Management TIMPs for Jute Mallow

Rapid Soil Testing Services

1.4. TIMP name	**Rapid Soil Testing Services**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are expensive for farmers, results take long and are not reproducible. Further, conventional methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing using the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It does not require the routine laboratory analysis using chemicals. When a sample is run though a scanner, soil testing results are generated with accompanying recommendations instantly. However, the method requires partners involved (ICRAF, iSDA and SoilCares) to work closely with KALRO and county agricultural officers to sensitize farmers to embrace the testing method. This innovation will involve working closely with agronomists to generate specific fertilizer recommendation driven by soil and crop data obtained.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches used in dissemination	Farmer visits Training in workshops Publicity campaigns done at County levels

Critical/essential factors for successful promotion	• Availability of the necessary equipment (Scanner and accessories) for rapid on-site soil testing. • Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. • A well-designed information storage system for data obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data, fertilizer recommendation according to crop type suitability). • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	• County government extension services; Providing the link to farmers. • Soilcares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and iSDA; Tests and validate the recommendations obtained in collaboration with SoilCares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Technology has not been promoted though testing has been ongoing in a few counties
Current Counties where already promoted if any	Minimal reach in Nyeri County
Counties where TIMP will be promoted	All 24 KSAP Counties
Challenges in dissemination	• It requires continuous updating of methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated methods for updating existing recommendations by generating local soil libraries.

Lessons learned if any	Timely affordable soil information will guide on fertilizer use. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Copper.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly; -Recommendations provided ensures that farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Market will absorb the increased productivity • Supporting frameworks/policies are available. • Training of personnel at national and County levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Soil testing equipment and License, sampling and packaging materials (Kes 650,000/=), personnel and logistics (will depend on site/location). • Shipping selected soil and plant materials for further testing and results verification in a certified lab. • There are other additional costs on professional consultation.
Estimated returns	At least 30% profit for soil testing business venture using the scanner. Farmers end up getting higher returns on the crops grown and amounts depend on specific value chain. High value crops will give higher returns compared with subsistence crops.
Gender issues and concerns in development, dissemination, adoption and scaling up	• By bringing services closer to the users saves farmers (men, women and youth) time and resources.
Gender related opportunities	• Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. • The scanner equipment is light and women and youth can easily transport and operate it.
VMG issues and concerns in development, dissemination, adoption and scaling up	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and is also expected to improve productivity
E: Case studies/profiles of success stories	
Success stories	Has been tested used successfully by other organizations like ICRAF, SoilCares & former Kenya Sugar Research

	Foundation. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugar cane
Application guidelines for users	• A handheld scanner to test soils and crops in the field • Community soil sampling champions are identified and trained on good soil sampling procedures. • Soil and crop is analysed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO; C. Kibunja, E. Gikonyo, Christy van Beek, A. Sila, D. Kamau, A. Esilaba and S. Kimani
Partner organizations	County governments in the 24 counties, SoilCares, ICRAF and iSDA

Research gaps

1. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
2. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities as per farmer needs.
5. Using scanners at farm level to undertake fertilizer quality analysis, e.g. quantitative and qualitative analysis, major and trace elemental analysis, and chemical and physical analysis.
6. Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country

Integrated Soil Fertility Management (ISFM)

1.1. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil fertility, low organic matter, poor soil structure and limited available moisture in crop production.

What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed and good agronomic practices to adapt to local conditions. ISFM places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence
Justification	Soils within the farming system are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. The aim of ISFM is therefore to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Training in workshops On-farm visits Farmer field schools (FFS) On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; • Availability of clean/certified seed • Availability of novel crop protection practices, and • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming

	families are able to invest in
Partners/stakeholders for scaling up and their roles	• County government extension services - Provide linkage with farmers. • Community farmer groups - play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Current Counties where already promoted if any	Practised in some value chains in the 10 Counties above
Counties where TIMP will be promoted	Bomet, Kericho, West Pokot, Taita Taveta, Lamu, Nyandarua, Tana River, Baringo, Marsabit, Garissa, Kajiado, Laikipia
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Lack of guidelines on how to combine manures/organic materials with modest amounts of mineral fertilizers. • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, etc is required since farmers tend to re-use previous planted materials. Knowledge of how to combine organic and inorganic fertilizers is required.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Increased productivity will provide supply to the markets, • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically demanding technology and high cost are incurred in acquisition of inputs.
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice integrates participation of male and female gender roles during field activities. Female gender is disadvantaged where application of heavy loads of manure is to be incorporated in the field.

	Adoption and scaling up of ISFM technologies could be affected by: Ownership of the farm, that are mainly male owned but the implementer of the ISFM in most cases is female Quality inputs and their availability in time
Gender related opportunities	Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that save on cost which benefits all gender in the farm household.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs are physically disadvantaged for a practice that seeks to incorporate manures, and chemical sprays in the farm. They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice
VMG related opportunities	The technology if well practised can increase farm incomes of VMGs by up to 50%.
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in maize in central and western Kenya highlands. Successes have also been reported for sorghum and millet value chains in Machakos where the productivities have been improved
Application guidelines for users	• Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. • Ensure that good agronomic practices are upheld • For sustainability, use of pure inorganic or organic materials should be avoided but should be used in recommended combinations. • Adapt the practice to local conditions
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete Q. O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; E. Gikonyo, C. Kibunja, A. Muriuki, D. Kamau, A. Esilaba, J. Ndufa and S. Kimani
Partner organizations	County governments, NGOs, CIGs, KEFRI

Research Gaps

1. Validation of the ISFM technology in Counties where technology has not been tested.

2. Testing (fertilizer types, rates, frequencies) and combination with manures for different value chains

Integrated Manure Management (IMM)

1.2. TIMP name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)  *Source: J. Oyoo, Tigoni*	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops. Manure is obtained from different animals (poultry, cow, goat, horse) on the farm, but it can also be bought from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties all of which are important for soil quality and crop production.
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are depleted at annual rate of 22kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health. The efficient use of manure is enhancing the capacity of the soil to conserve and accumulate soil organic carbon; maintain or improve crop yield by supplying nutrients when required by plants and reduce effects of climate change through sequestration of carbon.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

	Public and private practitioners
Approaches used in dissemination	On-farm and on-station demonstrations Open and Field days Agricultural shows MoA/Extension officers Partners Farmer to farmer peer learning Mass media- e.g Mkulima programme, Smart Farmer and Seeds of Gold Workshops, Seminars, Meetings, trainings Promotional materials (posters/brochures/leaflets) Social Media platforms Exchange visits
Critical/essential factors for successful promotion	• Training on feeding, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using several crops
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I)-National and County level -extension services and link with farmers CIGs (Common Interest Groups)- co-ordination roles and back stopping at grass root levels ILRI- technical backstopping NGOs (Non-governmental organizations)-promotion, micro financing etc.
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Uasin Gishu
Current Counties where already promoted if any	Though small scale farmers in the counties apply manures and composts on their farms, they do not optimize on usage.
Counties where TIMP will be promoted	Bomet, Kericho, Laikipia, West Pokot, Taita Taveta, Nyandarua, Lamu, Tana river, Baringo, Marsabit, Garissa, Siaya, Kisumu
Challenges in dissemination	• Limited model demonstration farms • Cultural challenges -Lack of interest by pastoral communities • Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers

	• Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	• Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure preparation, storage and application
Social, environmental, policy and market conditions necessary	• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbour pathogens which can cause disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time. Manure costs are dependent on types e.g. goat, sheep, poultry Using locally available manure/composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practised
Gender issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application (often by broadcasting) hence may disadvantage women and youth
Gender related opportunities	Manure is locally available for farm households who keep livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application hence may disadvantage VMGs. The VMGs are also resource poor, hence may not have access adequate manures, e.g. need large livestock herds
VMG related opportunities	Manure is locally available for those farm households with livestock and can build on what they already own
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and

	sustainable source of income e.g. keeping one steer in a smallholder farm measuring 0.45ha in central Kenya produces manure equivalent to 112kgN/ha/year of whole farm area when optimum collection and manure composting strategies are followed.
Application guidelines for users	The guideline focus on the following areas:- • Animal feeds • Livestock housing and manure collection • Manure storage to preserve nutrient and avoid loses • Manure treatment for ease of transport and application in the field • Timing of application for maximum utilization by the crop • Anaerobic digestion for biogas production • Regular analysis of manure to ascertain the quality • Manure/Composts take a long time to cure, hence need good planning prior to use • IMM is always site specific and users advised to only use information relevant to local circumstances
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations	County government, Private Public Partnerships, CIGs

Research gaps

1. Promote IMM complementary technology in counties that have not practised it.
2. Conduct nutrient budget study on selected farms utilizing manures (including composts) in each of the 24 Counties.

Soil and Water Management TIMPs Jute Mallow

Rain Water Harvesting Through Roof Water Catchment

2.6. TIMP Name	**Rain Water Roof Water Catchment**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)  *Source: C. Kundu,*	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface run off). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. Examples of rainwater harvesting are rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage By collecting, storing and utilizing water agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high- value crops, and extending their growing season through the entire year. Technology also slows water run off and increases yields with the additional water
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralists
Approaches used in dissemination	Demonstrations on technology use; Farmer Field Schools; Technical training and re-tooling of extension personnel; Awareness creation through various platforms like local FM stations
Critical/essential factors for successful promotion	• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems • Policy to support use of communal land to establish and manage the earth dams • Policies supporting Public-Private Partnerships in water harvesting • Sensitization of local communities to embrace the practice
Partners/stakeholders for scaling up and their roles	• Private sector – access to technology, access to credit, technology installation • County government – capacity building, policy support, credit facilities, • NGOs – access to technologies, capacity building, technology installation
C: Current situation and future scaling up	

Counties where already promoted if any	Most counties are investing on water harvesting technology at community level. More is required to increase uptake at household level
Current Counties where already promoted if any	Practised widely in most counties
Counties where TIMP will be promoted	ASAL counties; Tana River, Marsabit, West pokot and Mandera
Challenges in dissemination	• High costs related to technology access and management • Resource use conflicts where land is communally owned • Limited skills in technology installation and management • Limited community mobilisation policy for water related activities • Lack of suitable training programmes in rainwater harvesting • Lack of proper water usage and control measures • In the case of earth dams where there is a lot of siltation, regular de-siltation is required. • Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance. • Vandalism • Some systems require high investment costs
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training programs water harvesting technologies, maintenance and operation skills • Cost of buying water harvesting structures is very high for most households and needs to be reviewed. • Securing systems to prevent vandalism
Lessons learned if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented
Social, environmental, policy and market conditions necessary	• Devise systems that are gender sensitive – target different gender needs • Carry out environment and social impact assessment of the technology in specific Counties and cultures • Support structures that help access to credit for technology access and maintenance • Enact Policy frameworks to support water harvesting

	• Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost dependent on the type of materials to use for harvesting and storage. Not readily affordable to most rural households
Estimated returns	• Time saved fetching water from afar is channelled into other economic enhancing activities. • Money used to treat diseases related to poor water hygiene is used for other activities. • Healthy population will have energy to provide labour required in agricultural activities
Gender issues and concerns in development, dissemination, adoption and scaling up	• The distance from household need to be considered as women are the custodian of households in terms of domestic water demands. • The design of the water pans should take care of the Occupation, Health and Safety of the communities • The technologies will reduce time needed to fetch for water which will impact positively the women
Gender related opportunities	Water harvesting facilities save the time spent to collect water from far off, usually by women. The saved time is channelled into other economic activities
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to credit or financial services may limit access to technology • The land tenure systems may inhibit adoption of technology
VMG related opportunities	• Develop SME opportunities around water harvesting. Also do small food gardens and tree nurseries around water pans • VMG maximize can engage in n availability of water to engage in small IGAs around water harvesting • Livestock too easily access water and their market value likely to appreciate • The technology will reduce the time used to search for water
E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres.

	This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	Agro-pastoralists and farmers in target counties need training and empowerment on the technology and attendant management practices. **References** Handbook on Rainwater Harvesting and Storage Options Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPPs

Research gaps

2. Development of models of rain water harvesting for intensive agricultural production and household use

Mulching

2.3. TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in the soil, weed infestation, loss of organic matter, managing salinity in ASALS and low crop yields.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials such as straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production. Plastics like polythene, and row covers are also used as mulch.

	Benefits: retain moisture in the soil; suppress weeds; lowers soil temperature; and help improve soil fertility (as the mulches decompose).
Justification	Mulching facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It minimizes weed problems and nutrient loss. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	• Farmer field schools • On-farm demonstrations during farmer field schools • Training in workshops
Critical/essential factors for successful promotion	• Availability of plant or crop residues. • Size of the land. • Competing uses of crop residues. • Type of the crops
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers • Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Current Counties where already promoted if any	Available and practised in different commodity value chains
Counties where TIMP will be promoted	All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses • Possibilities of insect build up categorized as pest or disease vectors
Suggestions for addressing the challenges	• Crop diversification to increase availability of residues. • Establish and follow a good integrated pest control management program for the particular crop. • Adapting alternative mulching materials like high absorbance polymers in fruit trees like mangoes and Bananas, as well as plastic mulches and row covers in vegetables
Lessons learned if any	There is need to adapt alternative mulching technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes.

Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive practice during the initial application. Such costs are dependent on value chain and plant spacing. However, plastic mulch is costly and needs to be used for high value crops.
Estimated returns	Dependent on the type of value chain and mulch used
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict for those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere. Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is be a bit labour intensive for VMGs, hence its adoption and scaling up
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	Judith Henze, Mary Abukutsa-Onyango, and Arnold Opiyo, 2020. Production and Marketing of African Indigenous Leafy Vegetables. Training Manual for Extension Offcers and Practitioners
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling (Organic mulch) 2 and 3= Requires validation and further research(plastic mulch)
G: Contacts	
Contacts	Centre Director KALRO Kabete. P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma, P. Kitiem, J. Mwaura, A.

	Esilaba, D. Kamau and S. Kimani
Partner organizations	County governments Public-Private-Partnerships

Research gaps

2. Research on mulching using plastics, factory/industrial wastes, e.g. mushroom, tea, coffee, etc. in different value chains is required

Irrigation and Drainage Management Jute Mallow
Solar irrigation systems for smallholder farmers

3.1. TIMP name	**Solar Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High cost of pumping water for irrigation, using electricity or fossil fuel powered pumps; reduction of greenhouse gas emissions
What is it? (TIMP description)	This is a technology that uses solar power in the pumping of irrigation water and running of the irrigation systems
Justification	There has been general increase in prices of diesel and electricity making pumping of irrigation water to be a costly operation. Though Solar panels have been used successfully to light houses and in small businesses in the rural areas, they have hardly been used in the irrigation systems despite their potential. Solar power would be a good source of power for addressing climate smart agriculture focusing on renewable and green energy. It also has the advantage of low cost and sustainability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	On-farm and on-station demonstrations Field days Training in workshops Stakeholders forums Technical releases
Critical/essential factors for successful promotion	• Documentation of available solar irrigation systems • Access to solar irrigation performance data. • Improving solar irrigation systems efficiencies in irrigation schemes • Creating local support for solar irrigation technologies
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	

Counties where already promoted if any	Various Counties including Marsabit, Garissa, Machakos, Nyeri, Kajiado, Siaya, Bomet, Kericho and Uasin Gishu
Current Counties where already promoted if any	Practised in individual farms as well as in few group farms for high value crops like tomatoes
Counties where TIMP will be promoted	All the 24 KCSAP Counties
Challenges in dissemination	• Farmers lack knowledge on the potential of solar as a power source for irrigation systems • High cost innovation
Suggestions for addressing the challenges	• Awareness trainings on different solar irrigation systems • Awareness creation on advantages of solar irrigation systems pumps to governments, farmers and development agencies. • Capacity building of extension workers • Developing information packages • Creating solar irrigation systems network
Lessons learned if any	• Solar irrigation systems should be well designed in water delivery, storage and application to the field.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Policies are friendly to the technology • Capable of increasing marketable products
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Higher investment costs but low operation costs. Costs depend on the energy required and size of irrigated area.
Estimated returns	• Not yet done
Gender issues and concerns in development, dissemination, adoption and scaling up	Solar irrigation is friendly to female gender compared to diesel or electric systems because they have low running and maintenance costs. It is modern technology that is attractive to the youth
Gender related opportunities	The systems are adaptable to different irrigation scenarios thus fitting to all genders.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs may not afford the investment costs but will afford the operational and maintenance costs if assisted
VMG related opportunities	The technology can increase farm incomes of VMGs by more than 70% because of the very operation and low maintenance costs
E: Case studies/profiles of success stories	
Success stories	Solar irrigation systems success stories have been reported in Counties such as Kajiado on high value crops
Application guidelines for users	Choose a solar irrigation system that suits the farm area to irrigate

	Use efficient water application method such as drip to avoid wastage since the water is relatively scarce.
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; I. V. Sijali, M. P. O. Radiro, F. Karanja, F. Kaburu
Partner organizations	Solar irrigation systems suppliers County governments National Irrigation Acceleration Programme (NIAP)

Research Gaps

1. Validation of the solar irrigation systems in the different counties.
2. Up scaling of the technology to smallholder community schemes
3. Solar irrigation systems that maximize crop water productivity
4. Drip Irrigation Systems

3.2. TIMP name	**Drip Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Increased crop water stress caused by seasonal rainfall variability in rain fed production
What is it? (TIMP description)  Layout of a drip irrigation system in vegetables	This is a technology that supplies water to plants grown in solid substrates in small controlled drops. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water
Justification	The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Main streaming drip irrigation systems into crop production provides the opportunity for farmers to enhance crop resilience, increase yields and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Model Farmers
Approaches used in dissemination	Field Demonstrations, farmer field schools, ASK trade and exhibition fairs

Critical/essential factors for successful promotion	• Correct field design (system installation) of the drip system to minimize water inefficiencies. Training of farmers and extension • Drip management skills
Partners/stakeholders for scaling up and their roles	• County governments; capacity building, supportive policies and frameworks • Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Bomet, Kajiado, Machakos
Current Counties where already promoted if any	Limited to high value tomato and vegetable farmers in the above counties
Counties where TIMP will be promoted	High value crop production (e.g. tomatoes, vegetables, bananas) in Elgeyo Marakwet, Bomet, Kericho, Kajiado, Mandera, Siaya, Tharaka Nithi, Nyandarua, Nyeri, Kisumu, Busia, Taita Taveta, Machakos, Isiolo, Laikipia, Marsabit, Baringo and Garissa counties
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Suggestions for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned if any	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil • It is also important to link farmers to Micro Finance Institutions for financial needs
Social, environmental, policy and market conditions necessary	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems • The water quality should be known to adjust the drip

	systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES 100,000
Estimated returns	● Income from drip system rises by as much as 35% stemming from the management of crop water stresses. ● Increased water saving means more water is available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	● Drip systems are easily installed and therefore suitable for both male and female gender ● Drip system tends to reduce workload for all gender and provides significant positive impact on family food and nutritional intake. ● Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours ● Acceptable and easy to scale up by both male and female, including youth
Gender related opportunities	Opportunities available for women and men to generate sustainable income
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMG
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables
E: Case studies/profiles of success stories	
Success stories	There are many successful farmer drip irrigation models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability
Application guidelines for users	● Use appropriate emitters during design and installation i.e. sites with elevation difference of over 1.5 meters (5 feet), use pressure compensating emitters and turbulent flow emitters more level areas. Gravity flow systems normally use short-path emitters ● Use 1 or 2 emitters per plant depending on the size of the plant. Trees and large shrubs may need more. ● In most situations install emitters at least 450mm (18″) apart. 600mm (24″) apart under 80% of the leaf canopy of the plant ● Always have a backflow preventer to prevent water contamination by soil-borne disease. Use a 20mm (3/4″) valve for most systems ● Use 25mm (1 inch) PVC, PEX or polyethylene irrigation pipe for mainlines (“mains”) and laterals ● The total length of the mainline and the lateral together

	should not be more than 120 meters (400 feet). • The length of drip tube should not exceed 60 meters from the point the water enters the tube to the end of the tube • Never bury emitters underground unless they are made to be buried • Don't bury drip tube, moles or other rodents will chew it • Always install a flush valve or end cap at the end of each drip tube. Automatic flush valves are also available **References** 3. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi. 4. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/a-i3765e.pdf
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	1 =Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Isaya Sijali,
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

Research gaps

1. The impact of drip irrigation on economics of agriculture in the regions of adoption under study
2. Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption

A: Description of the technology, innovation or management practice	
• Problem to be addressed	• Reduced yield due to pest and disease damage in Jute Mallow
Pest & disease management: • Use appropriate pesticides when applicable for Variegated grasshopper, Armyworms, Flea beetles, Jute semi-looper, Cotton leafworm, Jute stem weevil, cotton leafroller, Spidermites and root knot nematodes • Use of appropriate fungicides against fungal diseases such as Cotton foot rot, black leaf spots, cercospora leaf spot, anthracnose and charcoal rot • Management of okra mosaic virus disease	

• Integrated pest and disease management • Proper handling and application of pesticide chemicals	
Pest and diseases can cause up to 100% loss of yields if not controlled in time and in the right way	
B: Assessment of dissemination and scaling up/out approaches	
• Farmers	
• On farm and on station demonstrations • Farmer field schools • Field days • Agricultural shows • MoA/Extension officers • Partners: World Vegetable Centre, IITA,NGOs • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals)	
• Availability of inputs • Availability of affordable labor • Extension • Funding	
• Agricultural Extension : Farmer sensitization, On farm and on station demonstrations • Farmer leaders : Group organization • NGOs dealing with AIVs: Dissemination of the appropriate practices	
C: Current situation and future scaling up	
• Counties where already promoted if any:	Homabay, Siaya, Kisumu, Busia. Makueni, Kitui, Machakos, Tharaka-Nithi, Embu, Meru
• Counties where TIMP will be up scaled:	Baringo, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Categorisation of AIVs as poor man's crops and so do not require management of pests and diseases • Up-scaling and creating awareness • Hands on training in appropriate pest and disease management practices
Suggestions for addressing the challenges	• Changing the notion that AIVs are a poor man's crops and creating need for proper management • Frequent Policy review to subsidize farm inputs • Enabling policy and policy review from time to time • Policy to incorporate in baby food formulations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Estimated revenue per acre	
• Labour intensity on women • Lack of financial resources by women	

• AIVs mainly cultivated by women hence empowering them with information will promote production and productivity	
• Labour intensity • Illiteracy, poverty, market access problems	
• Affordable inputs	
E: Case studies/profiles of success stories	
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	
Lead organization and scientists	
Partner organizations :	Agricultural University Colleges, MoALF, Retail market outlets

6.5 AIVs Crop Health

TIMP Name	**Integrated Weed Management**
Crop management practices	Management practices 
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds reduce profitability in AIVs production system. They compete for nutrients, soilmoisture and space with the crop and also harbor insect pests and create an environment conducive for disease occurrence. This adds costs to production. Major weeds in AIVsproduction include grass weeds such as couch, kikuyu grass, star grass and annual weeds such as black jack, gallant soldier, mexican marigold and wandering jew. Different weeds require various strategies for effective control,

	hence producers should combine two or more of the methods to management weeds. Significant yield losses in AIVs production are attributed to poor weed management. Proper weed management is necessary to increase productivity
	Common weeds affecting AIVs production
	
	Wandering Jew (*Commelina Benghalensis* L.) Source Hottensiah Mwangi
	
	Double thorn (*Oxygonum sinuatum* (Meisn.) Dammer associating with crows foot (*dactyloctenium aegyptium*) and *Ragwort* (*Senecio discifolia* Oliv.) Source Hottensiah Mwangi
	

		
	Gallant soldier (*Galinsoga parvifloraCav.*)	Blackjack (*Bidens pilosa* L.)
		
	Digitaria veluntina (Forssk.)P. Beauv.	Wild finger millet (*Eleusine indica* (L.)Gaertn.)

		
	Purslane (*Portulca oleraceae L.*) Source Hottensiah Mwangi	*Late weed* (*Trichodesma zeylanicum*) amonggrass weeds Source Hottensiah Mwangi
		
	Goat weed (*Ageratum conyzoides* L.)	Sow thistle (*Sonchus oleraceus* L.)
		
	Terere (*Amaranthus graecisans*)	Oxalis (*Oxalis latifolia* H.B.K)

		
	Chickweed *(Stellaria media* (L.) Vill.	Wild lettuce (*Launaea cornuta* (Oliv.&Hiern))
		
	Parthenium (*Parthenium hysterophorus*)	Thorn apple (*Datura stramonium* L.)

		
	Asthma weed (*Euphobia hirta* L.)	Wild raddish (*Raphanus raphanistrum*)
		
	Starbur (*Acanthospermum hispidum* DC.)	Eshaaga (*Eracustrum arabicum* Fisch.&Mey.)
		
	Chinese Lantern (*Nicadra physaloides*)	Tar vine (*Boerhavia diffusa L.*)
		

	Nutsedge (*Cyperus rigidifolius* Steud.) Source Hottensiah Mwangi	Couch grass (*Digitaria abyssinica*) Source Hottensiah Mwangi
What is it?(TIMP description)	Integrated weed management (IWM) is using of several weed approaches such as preventive, physical control, biological control, use of biodegradable mulch, cultural, mechanical and chemical control the management of weeds . Physical control is the removal of weeds manually or mechanical means, such as hand weeding or mowing. Biological control is where you graze by big animals. Chemical control is where appropriate herbicides are used to control weeds. Cultural control includes the practice of crop rotation since various crops may influence the diversity and abundance of particular weed flora. Select robust growing varieties that cover the soil and suppress weeds in rotation. Mechanical weed management includes use of farm implements e.g use of a motorized knap weeder, which does the work much faster and is less tedious. Chemical weed management involves use of pre-emergence selective herbicides and or post- emergence selective herbicides. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks).	
Justification	The wide diversity of weeds affecting AIVs cannot be effectively managed by one approach such as manual approaches commonly used by majority of farmers. Whereas this is effective, it is time consuming and labour intensive. Whereasmanual weeding could be effective, it may also be ineffective when carried out under wet conditions; all weeds maybe apparently replanted. Therefore regrowth becomes a big problem. AIVs producers should therefore selectone or more approaches to keep weeds under control.  Weeds left in the intra row when using plough with draught animals can be uprooted manually.	

	  Hand weeding & Back breaking labour burden in common weeding practice weeded field  Identify the weed diversity and density to make appropriate control measure
where already promotedif any	Laikipia, Nyeri
Countieswhere TIMPs will be upscaled	Laikipia and Nyeri
Challenge s in developme nt and disseminat ion	High cost of herbicides Inadequate knowledge and information on which herbicides to use and when to usethem Myths on appropriateness of using herbicides
Suggestio n for addressingthe challenges	Promotion of the product by conducting demos and field days and involvement ofthe stakeholder e.g. agro-chemical company

	Develop and disseminate information to various stakeholders Training on integrated approaches using available methods, including appropriateherbicides and their use of herbicides – safety
Lesson learned inup scalingif any	That integrated approaches of weed management are more effective than use of onecontrol method and is safe on environmentally friendly. Continue use of herbicide is environmental, health and social hazard.
Social, environmental, policy andmarket conditions necessary for developme nt and up-scaling	Train on understanding the working of an integrated weed management.Have an environmental and safety plan when using herbicides Address the environmental and social concerns related to use of agrochemicals. A functional agrodealer network to supply the products when required by thefarmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basiccosts	Ksh 4000
Estimatedreturns	KSH 1000 per acre
Gender issues and concerns in development dissemination, adoption and scaling up	Women and youth have limited access to production resources such as land, capital to purchase some of the inputs used for IWM Women work is complicated by their multiple roles they do such as such domestic roles Women and youth have limited access to education, training and extension services Women have less access to agricultural information, technology and knowledge on IWM Women and youth have less access to knowledge and information on IWM Use of IWM technology can reduce labour from manual weeding and save time for other activities for women and children
Gender related opportunities	Women and youth to generate income from weeding Women and youth to generate income from agro dealer business Women and youth to generate income by starting cortege value addition factories due to enhanced yield There will be improved food security and nutrition from for women There will be increased job security for women and youth by spraying herbicides There will be increased production since the weed competes with plants leading to low production
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	VMG groups could have limitations in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes. VMG have less access to extension training as they are not given equal opportunities VMG have less access to knowledge and information on IWM VMG have less access to capital to purchase herbicides

VMG related opportunities	VMG to generate income from agro dealer business VMG to generate income by starting cortege value addition factories due to enhanced yield There will be increased production leading to increase food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Successstories	
Application guidelinesfor users	Extension and training material available
F: Statusof TIMPReadiness (1. Ready for up scaling; 2. Requires	Ready for up scaling
validation;3. Requiresfurther research)	
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organizati on and scientists	KALRO , Kabete Dr Hottensiah Mwangi, Dr Jedidah M. Maina, Charity, W. Muchira, Dr. RuthAmata, Dr Violet Mumanyi
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, CountyGovernments, KEPHIS

Research Gaps:

Determine cost benefits of using motorized knap weeder versus other IWM in AIVs production

3.3. TIMP Name	**Land Preparation Practices to control weeds in AIVs**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	A weed biodiversity infests in AIV cropping systems that contributes to poor crop and yield loss across the agro ecological zones in Kenya.

	 Poorly prepared land Unprepared Land
What is it? (TIMP description)	Land preparation covers a wide range of practices from zero-tillage or minimum tillage through to conventional ploughing using hand hoe, ox plough or tractor. It typically involves (1) plowing to "till" or dig-up, mix, and overturn the soil; (2) harrowing to break the soil clods into smaller mass which exposes weeds seeds from seed banks. Land preparation can be by ridging's which can be done manually or mechanized by use of tillers. It is done during the dry weather when soils are easier to work to make save site for AIVs seeds. We recommended this to be 3-4 weeks before the rain commence. For no till choose appropriate herbicides and follow the manufacturers label and recommendations specific to each herbicide. Apply post emergence on vigorously growing weeds to clear the difficult to control weeds such as couch grass, nut sedges among others. The most common herbicides used is Glyphosate with trade names such as Round up, Glycel, Kausha, weedal.
Justification	Land preparation is important to control weeds and ensure that the AIVs field and ready for planting and also facilitate obtaining a uniform crop depth resulting to almost uniform germination. This enables to minimize yield loss and increase productivity because AIVs are poor competitors. It controls weeds, and provides a soft soil mass suitable for direct seeding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers in all AIVs suitable regions
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Land preparation using pre-emergence in steep areas can lead to soil erosion and herbicides getting to water tables. Train producers on available options using practical demonstrations Participatory field days with farmers groups and stakeholders Provide communication products eg brochures
Partners/stakeholders for scaling	County extension staffs,

up and their respective roles.	Tractor/Plough service providers, NGOs, Research organization (KALRO, CIAT)
C: Current situation and future scaling up	
Counties where already promoted. if any	Conservation Agriculture/Minimum Tillage for land preparation in laikipia,Nakuru, Tractor ploughing in Nakuru, Laikipia, Trans Nzoia, Bungoma, Bomet, Narok, Nandi, Kakamega
Counties where TIMPs will be	All suitable areas
Upscaled	
Challenges in development and dissemination	• Limited biological knowledge on weeds such as couch grass. • Small land holding limiting tractor mechanization • High cost of using mechanized options
Suggestions for addressing the challenges	• Promotion of the low cost mechanization technologies where possible. • Tractor hire service by County and other serviceproviders • Training for land preparation to control weeds under no-till, minimum tillage and farmers practice.
Lessons learned in up scaling, if any	Good land preparation minimises weed infestation, results to increased yield and moisture retention especially where ridging is practiced and weeds sprayed post emergence herbicides.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Land size and topography influences choice of land preparation method to manage weeds. • County tractor subsidy program can help promote mechanization for land preparation. • Use of small hand tractors hould be made accessible, affordable and easier to operate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 4,500 per acre
Estimated returns	6000-7000 Ksh
Gender issues and concerns in development, dissemination, adoption and scaling up	• Use of low cost land preparation technologies that are affordable to women farmers • Promote labour saving technologies to benefit women who are major players on land preparation • Land preparation during dry period to ensure weeds dry up and subsequent operations easier and cheaper. • Early land preparation exposes the pest and diseases to the hot sun hence reduced build up of inoculum • Explore use of herbicides to kill weeds and save labour
Gender related opportunities	• Ensure Opportunities for using low cost, low labour land preparation technologies that does not exclude

	women.
VMG issues and concerns in development, dissemination, adoption and scaling up  	• High cost of land preparation • Access to the mechanized options for land preparation. • Some management practices such as Conservation Agriculture (CA) is friendly to the VMGs • The project should have provision on training of the youths
VMG related opportunities	• Group land preparation by VMG • There is a business opportunity for the for the youth using low cost mechanization- e.g. ox-ploughs, walking tractors in land preparation service enterprises
E: Case studies/profiles of success stories	
Success stories	Farmers in Embu and Nyeri have realized higher returns after this practice and have attained Lucy Waihiga who
	increased yield from 45-180kg from ¼ acres
Application guidelines for users	The small walking tractors are available in the Counties and training on use of small equipment and mechanization
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Katumani, KALRO Embu
Lead organization and scientists	KALRO Katumani
Partner organizations	KALRO, CIAT-PABRA, Seed Companies, Mechanization partners e.g. Ikonic, Hello Tractor, Conservation Tillage Network in Nairobi

TIMP Name	**Legume Intercropping System**
Categories (i.e. technology innovation Or management practice)	Innovation Picture **Legume AIVs intercrop**
A: Description of the technology, innovation or management practice	
Problem addresses	Weeds invading the bean fields competiting for resources nutrients, water and space. Planned inter-cropping of beans with other crops - cereal (maize or sorghum) tubers (cassava), bananas, cash crops (coffee) gives returns. Poor intercropping results in low yields attributed to competition for light and nutrients and may lead to increased infestation of pests and diseases. Good intercropping to effectively control weeds **Cowpea finger millet intercrop**

	 requires specific spacing, the right variety of legume depending on growth habit of the intercrop. Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition.
What is it? (TIMP description)	Innovative Legume Intercropping Systems is the application of growing more than one crop in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use. Intercropping systems are defined based on the temporal and spatial arrangements of the crops.There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Innovative AIV intercrop  Cowpea millet-sorghum intercrop
Justification	Cropping of several AIVs plant species together reduces negative effects of amonoculture and thus is commonly employed in ecological

	agricultural
	systems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is compatible with the principles of balanced agriculture. Intercropping systems provide better soil cover hence reducing weed incidences. Intercropping has important advantages in regard to efficient land use, increasing crop productivity and monetary returns thanks to effective use of various inputs compared to sole cropping. It can significantly increase total productivity as compared to sole cropping thanks to better utilization of water,nutrients and solar energy. Crops in these systems use available resources more efficiently thanks to different rooting and canopy properties which component plants species exploit resources complementary. Intercropping systems can cause more effective use of resources by providing symbiotic nitrogen from legumes, or making available inorganic phosphorus fixed in soil because of lowering of pH via nitrogen fixing legumes. Intercropping systems is a climate adaptation strategy in case of crop failure in mono cropping and is considered as one of the most dependable ways to maintain the sustainability of crop production. It is a risk mitigation strategy by farmersin light of prevailing climate change. Intercropping practices can ensure higher yield as well as productivity and profitability in crops per unit land. Intercropping systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources andprofitable than mono-cropping systems. Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, and color and trapping effects between intercropsinfluence insect or disease situation or their natural enemies. Crop rotation and intercropping practices decrease weed population density and biomass yield Success of intercropping systems over sole cropping can be achieved by careful agronomic manipulations and planning schedules. These manipulations include planting time, plant density, available resources, intercropping patterns, Spatial arrangements, and harvest times.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Conduct demos band the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)
C: Current situation and future scaling up	
Counties where already	Altitude areas of 1,500-2,000 above sea level ie Bomet Nakuru, Laikipia, Nyeri, Kirinyaga, Murang'a, Bungoma, Kakamega, Siaya, Trans Nzoia, Uasin

promoted if any	Gishu.
Counties where TIMPs will be up scaled	Nyeri and Laikipia
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	Facilitation of training of county extension staffs Demos and field days
Lesson learned in up scaling if any	Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promoting in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	Women migtght not be aware that Legume AIVs intercrop is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for Legume AIVs intercrop Need to train, especially women, on how to implement the Legume AIVs intercrop systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs might not be aware of the use Legume AIVs intercrop in weed management VMGs have no finances so they might not have funds to purchase some of the input used for Legume AIVs intercrop Legume AIVs intercrop systems impede mechanization of the production system
VMG related	System diversification and yield stability will increase food availabilityleading

opportunities	to food and nutrition security at household level Improved income from production and marketing of beans and other crops-diversified incomes
E: Case studies/profiles of success stories	
Success stories	Nyamira, Kakamega, Siaya, Trans Nzoia, Uasin Gishu.
Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Require validation
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800,Nairobi
Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi, Dr Jedidah Maina and Charity W. Muchira.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

3.6. TIMP Name	**AIVs Intercropping**
Categories (i.e. technology innovation Or management practice	Management practices
A: Description of the technology, innovation or management practice	
Problem addresses	Low yeld production,in AIVs.
	Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing smoother weeds.
What is it? (TIMP description)	Intercropping of AIV is the practice of planting AIVs between other crops between rows such as cereal (maize, millets), tubers (cassava), and bananas. Intercropping must be planned to use space available and smother the weeds.

Justification	Cropping of several plant species together reduces negative effects of a monoculture and thus is commonly employed in ecological agriculturalsystems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is sustainable practice. Intercropping has important advantages in regard to efficient land use, It can significantly increase total productivity as compared to sole cropping to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently to different rooting and canopy properties which component plants species to exploit resources complementary. Success of intercropping systems over sole cropping can be achieved by some agronomic manipulations. These manipulations can be plantdensity, planting time, available resources and intercropping patterns.Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV producer, Seed producers, Extension staff
Approaches used in dissemination	Extension publications (posters/ brochures/leaflets) Partners -NGOs Demonstrations and field days, Agriculture shows/trade fairs and distribution of small sample, farmer participatory evaluations Seeds of Gold, Mass Media – e.g. Mkulima programme, Smart Farmer
Critical/essential factors for successful promotion	Availability of seed, Conduct demos and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company, AIVs value chain service providers
C: Current situation and future scaling up	
Counties where already promoted if any	Altitude area of 1500-2000 meters above sea level Bomet, Nakuru, Laikipia, Nyeri
Counties where TIMPs will beup-scaled	Laikipia and Nyeri
Challenges in development anddissemination	Inadequate AIVs seeds Inadequate information to stakeholders on optimal spacing options for the different varieties for the different AEZ
Suggestion for addressing thechallenges	Train the stakeholders and youths in seed production Conduct demos and field days to demonstrate on benefits of intercropping and also mono cropping correct spacing through use Farmer Field Business School (FFBS) and Agricultural Innovation Platforms (AIP)

Lesson learnt in scaling, if any	Farmers who have learnt of the technology through field days and demos are currently user of the new technology. Alternative method (mechanization - planter) may lessen the work Capacity building and awareness campaign on proper spacing and intercropping are required.
Social, environmental, policyand market conditions necessary for - developmentand up-scaling	The technology is socially acceptable, good for environment, and the market irs ready for development and up-scale. The practice minimizes the use pesticides and surface run off since they also act as cover crop
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice although it has a limitation of using herbicides. The weeds get suppressed by the canopy cover.
Estimated returns	Considering the land equivalent ratio the return are expected to be higher in the intercrop being done at subsistence level for food security. If the focus is business oriented and mechanization is employed it may bring the cost of production lower.
Gender issues and concerns indevelopment, dissemination adoption and scaling up	Women migtght not be aware that AIVs intercropping is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for AIVs intercropping .Need to train, especially women, on how to implement the Legume AIVs intercropping systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues andconcerns in development, dissemination, adoption andscaling up	VMGs might not be aware of the use Legume AIVs intercropping in weed management VMGs have no finances so they might not have funds to purchase some of the input used for AIVs intercropping Legume AIVs itercropping systems impede mechanization of the production system
VMG related opportunities	System diversification and yield stability will increase food availabilityleading to food and nutrition security at household level Improved income from production and marketing of beans and other crops-diversified incomes

Gender issues and concerns indevelopment, dissemination, adoption and scaling up	Operations in row planted with AIVs are easier. Training on optimum training should target majorly women who are the ones who play key role. .
Gender related opportunities	Optimum spacing and row planting opens space for mechanization, which would reduce drudgery this benefiting the women.
VMG issues and concerns in development, dissemination, adoption and scaling up	Information needs on spacing Training of farmers on optimum spacing
VMG related opportunities	Service provision for mechanized planting of beansExtension support to other farmers
E: Case studies/profiles of success stories	
Success stories	Some farmers in Kieni in Nyeri County have moved from 1 bag to 4 bags (90kg bag) Farmers have reported improved soil conditions, reduced runoff and buildup of nutrient loss, soil moisture retention in the soil and generally an increased crop production following application the practice.
Application guidelines f orusers	Extension and training material available such as brochure
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO EMBU Vice Chancellor University of Nairobi Kabete Campus Vice Chancellor, Egerton University
Lead organization andscientists	KALRO Embu – Catherine Muriithi and Dr Alfred MicheniEgerton University- Prof Paul Kimurto University of Nairobi –Prof Paul Kimani
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed ,NGOs, CBOs,County Governments, KEPHIS

2.7.3. TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds infestation, soil moisture and loss of organic matter, in

	ASAL.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials or synthetic materials to control weeds fromseeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or natural mulches including straw, dead leaves and compost to make
	more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used in growing for long season AIVs. Only black mulches should be used to control weeds. Benefits: Organic mulches suppress weeds while retaining moisture in the soil; keep the soil cool; improve soil fertility (as the mulches decompose) and improves microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weedseedlings and weed seeds.
Justification	Organic mulching has added benefits other than minimizingweeds infestation, it facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing rain dropimpact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable and effective in weed control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	- Farmer field schools - On-farm demonstrations during farmer field schools - Training in workshops
Critical/essential factors for successful promotion	Organic: - Availability of plant or crop residues for organic mulches. - Size of the land. - Competing uses of crop residues. - Type of the crops Synthetic Cost of materials Disposal of material after use.
Partners/stakeholders for scaling up	County government extension services; Provide link with
and their roles	Farmers Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	

Counties where already promoted	Not used in beans in Kenya. Used in Thailand.
Current extent of reach	Available and practiced in different commodity value chains
Counties where TIMP will be promoted	Where beans are a priority value chain. All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses in organic mulches. • Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.
Suggestions for addressing the challenges	• Crop diversification to increase availability of organic mulches. • Establish and follow a good integrated pest control management program for the particular beans. • Adapting alternative mulching materials like high absorbance polymers in AIVs.
Lessons learned	There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	Mulching work is mainly done by women who have any other roles creating more work for them Women might not be aware that mulching is used as a weed control Women have limited access to productive resources such as land so they might not have enough residues to do mulching The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	There is potential of reduced workload for women Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is labour intensive for VMGs, hence its adoption and scaling up is a challenge. VMGs have limited access and control of productive resources such as land The VMGs have no finances to pay hired labor due to limited access to credit facilities
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including

	VMGs can take advantage of the practice Improves food production and nutrition for VMGs.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	User guidelines are dependent on value chain 1.Plant AIVs in clean seed bed 2 Apply mulch between the rows of AIVs. Mulch management Pull or kill weeds that grow out of the mulch near the AIV plant.
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further Research	Ready to use.
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira, Dr v Mumanyi
Partner organizations	County governments Public-Private-Partnerships

Research Gaps:

Determine cost benefits of using biodegradable biological and plastic mulch versus other IWM strategies in AIVs production

2.7.4 TIMP Name	**Chemical Weed Control**
Category (i.e. technology, innovation ormanagement practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Heavy weed infestation in AIVs fields
What is it? (TIMP description)	Chemical weed control refers a technique that involves the application of herbicide to control the growth of weeds or to soil to kill emerging weedseedlings and/ or weed seeds. Herbicide technology requires knowledge on herbicides required for specific crops, weeds occurring and the environmental conditions in the cropping system. Use ONLY Recommended herbicides where need be. .
Justification	Manual hand weeding is very labour intensive, scarce and

	expensive. Use of herbicides reduces drudgery and effects can be timely weed control.
Region promoted	Limited use of herbicide among small scalefarmers
Counties where TIMP will be upscaled	Herbicide weed control can be upscaled inall the areas where beans are being grown.
B: Assessment of disseAIVs mination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of chemicals
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successfulpromotion	Capacity building and training on safe useof chemicals for all users
Partners/stakeholders for scaling up andtheir respective roles	• Public and private partners –[MOALF&I) for extension, • Chemical companies for back stopping • ICRISAT for technical backstopping and promotion; • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro- finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale salesand marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Validation of these herbicides needs to be done before recommendations are given to the farmers.
Challenges in dissemination	Limited knowledge and information and low literacy levels among the farmers. Limited technical knowhow and knowledge on herbicide use and application which requires training for effective and safe use.
	The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing	There is need to train the agriculturalextension county

thechallenges	officers as TOTs on safe use of herbicides. This help in reaching the farmers with the information. Herbicides like all chemicals have to be used with care to avoid environmental and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for guidance on safe use of chemicals
Lessons learned	Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.
Social, environmental, policy and marketconditions necessary	Sensitization of communities on alternative methods of weed control and safe use ofchemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Herbicide use is cheaper than manual weedcontrol because it requires less labour.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Women and children are the main sources of labour in in AIVs farms • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities. • Women and youth have limited access to productive resources such as credit to buy weed control chemicals • Women and youth have limited access to education, training and extension services and on new technologies such as weed control chemicals • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels on types of chemicals to use at the farm level • Women have limited access to information, technology and knowledge on stalk disposal as compared to men • Women have got limited access to funding as compared to men to purchase the weed chemicals • There is slow information and awareness flow to female farmers due to their low academic levels
Gender related opportunities	• . The technology would create employment for the youth and women within the potatoes value chain • Youth could form groups and engage in spraying weed using weed control chemicals • The adoption of the TIMP will lead to reduced work for women as it will attract men into engaging into weeding There will be increased yields and sales leading to

	improved food and nutrition security
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit to access fertilizers and farmyard manures. • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	• Use of herbicides will improve weed management leading to increased productivity, increase availability of AIVs for consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
E: Case studies/profiles of success stories	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to containers on how to use.
F: **Status of TIMP Readiness (**1. Ready forup-scaling; 2. Requires validation; 3. Requires Research **)**	Requires validation and more research
G: Contacts	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr.Jedidah Maina, Charity W. Muchira.
Partner organizations	ICRISAT Nairobi; MoALF in Counties ,Chemical companies

Research Gaps:

Determine cost benefits of using chemicals versus other integrated weed management strategies inAIVs production

2.7.5 TIMP Name	**Mechanical weeding**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeding labour and timeliness in Weed management.
What is it? (TIMP description)	This is where an implement is used to weed after having planted clean certified seeds in weed free well prepared ground

	Planting should be done in rows to facilitate inter row weeding. Two weedings at 15 and 30 days after sowing (DAS) 2) **Row Weeders (Manual/ motorized)** These implements are used to weed between the rows. The intra row weeds are removed by hand pulling.
Justification	Weeds if not controlled will cause yield lossesdue to competition. The weeds will also hosts insects pests and pathogens increasing cost of production. This Lowers quality of the produce and reduces productivity..
Region promoted	All areas where AIVs grown
Counties where TIMP will be upscaled	All counties growing AIVs
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation. Field days, Shows, Farmer to farmer communication, Leaflets, Larger plot demonstrations.
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Jua Kali artisans • Processors and manufacturers to createmarket for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Limited research done on gender responsive weeding implements i.e row weeders are heavy and can only easily be handled by men
Challenges in dissemination	Implements not readily available in The market.

Recommendations for addressing the challenges	Work with Jua Kali industries for fabricationof appropriate implements.
Lessons learned	Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the available technologies and management practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of the weeder (implement is high - 28,000 for ordinally bean farmers, they can purchase as a group.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Mechanical weeding is labor intensive for all gender especially for women • Weeding increased labour for women who are already overburdened by their multiple gender roles • Women and youth have limited finances to pay labor services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in AIV farms • Women and youth have limited access and control of production resources such as land, credit to purchase farm equipment • There is need to equip women, youth and stakeholders with information relating to mechanical weed control method • There is also need to sensitize all genders on the losses caused by weeds and the importance of timely weed control.
Gender related opportunities	• Timely weeding will lead to increased potatoes production • There is a potential of creating employment for women and youth at various nodes of potatoes vale chain • Increased potatoes production will lead to increased household incomes and improved food security. • Mechanical weeding reduces labour for women as men are attracted to participate in weeding also
VMG issues and concerns in development , dissemination adoption and scaling up	• Mechanical weeding is not friendly for VMGs as it is labour intensive

	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG related opportunities	• Increased production will improve food security and nutrition for VMGs • If adopted the VMGs will get employment at various nodes of AIVs value chains • There is potential for increased incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Not yet accessible to bean farmers.
Application guidelines for users	Production manuals to include weed management TIMPs
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requiresfurther research**)**	3) Ready for up-scaling 4) Rower weeder is heavy so not friendly to women users. Research on gender sensitive weeders.
G: Contacts	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr. JedidahMaina, Charity W. Muchira, Dr. Ruth Amata
Partner organizations	ICRISAT Nairobi; MoALF in Counties

Research Gaps:

Determine cost benefits of using mechanical weeding tools e.g motorized knap weeder versusother Integrated weed management strategies in AIVs production

2.7.6 TIMP Name	**Safe Use of Agrochemicals**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Excessive pesticides application to crops, use of pesticides for spraying crops without wearing the right protective clothing, storage of pesticides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use of

	pesticides without following the guidelines provided on the labels. Inadequate enforcement of global policies and regulation on use of pesticide all lead Environmental, health and social concerns and problems affecting many AIV producing regions.
What is it? (TIMP description)	This is a practice of Capacity building stakeholders, crop protection teams on safehandling, application, use of pesticides right from transportation from
	the agro-dealers to storage in a special store, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large and community sorrounding. The management practice will include proper methodologies for pesticide disposal to minimize pollution of the environment.
Justification	Although cases of improper use of pesticides are very common in most of the areas where AIVs is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users and stakeholders'to be made aware of the best practices that should be used for save handling of pesticides. There has been reports of increase of chronic diseases in human beings attributed to pesticide misuse and safe use capacity building can reduce social, environmental costs of diseases
B: Assessment of dissemination and scaling up/out apprisoaches	
Users of TIMP	Farmers, AIV Producers
Approaches used in dissemination	Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinic, Pesticides spray Demonstrations
Critical/essential factors for successful promotion	Collaboration between all partners, willingness of farmers to adhere to proper guidelines Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers farmer groups/CBOs to participate in the implementation of the variousAIVs training on weeds management, KALRO and Universities to develop the technologies and conduct ToTs. CABI, AAK, PCPB, KEPHIS participate as stakeholders.
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	Nakuru, Trans Nzoia, Kakamega, Bungoma, Machakos, Makueni, Nyeri, Laikipia
Counties where TIMPS will be up scaled	All regions suitable for growing AIVs

Challenges in dissemination	• Change of mindset in favour of current practices maybe difficult to achieve, • Illiteracy and inadequate capacity to use pesticides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of pesticides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose pesticides properly
Suggestions for addressing the challenges	• Capacity building and sensitization forums for both farmers and agro dealers using participatory approach • Formation of youth spray teams • Establishment of aggregation centres for pesticide containers • Establishment of training of Extension staff and lead farmersas TOT • Increase surveillance along the border points and enforce the laws_
Lessons learned in upscaling if any	Upscaling of this technology needs young men and youth due toits hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collectionand incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.
Social, environmental, policy and market conditions necessary	Organized collective marketing channels and trainings are critical are for benefits tobe derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 60,000 per acre
Estimated returns	KES 500, 000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	• Technology is not safe for use by expectant women and the physically challenged individuals because of it hazardous/dangerous nature • Pesticides and protective gear are expensive and most women may not afford them • Lack of knowledge by men and women on the dangers of chemicals especially on storage and disposal • Low levels of illiteracy and inability to read and interpret the content of the herbsides labels especially on re-entry period after spraying and PHI. This cause herbecides poisoning to men and women who spray and harvest the AIVs
Gender related opportunities	• Formation of spray teams by men • There is reduced labour for women • Formation of spray teams by men and youths hence creating employment for the youth • The use of safe chemicals in weed management and control

	attracts men in weeding which traditionally used to be done by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• These are dangerous products that may not be handled by vulnerable groups • These are dangerous products that may not be handled by vulnerable groups. • Herbicides are expensive for VMGs to afford • VMGs have limited access to productive resources such as land, credit to access farm inputs such as herbicides • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	• Safe use of herbicide can easily be undertaken by the VMGs as employment where by they can form herbicide spray teams in the wards in each county and they charge for services provided • VMGs have the potential of operating agro-vets to stock farm inputs such as herbcides, pesticides, fertilizers among others • The use of weed control chemicals contributed to reduced labor burden for VMGs
E: Case studies/profiles of success stories	
Success stories	• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to pesticides • There are reported cases of farmers who regularly scout their crop that have reported to using less pesticides on their farm • Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction ofthese containers on farms • Safe use of Pesticide campaigns by AAK, PCPB KALROand MOLF&I have
Application guidelines for users	Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Develop technician and youth spraying teams with pesticide decision guidelines, manuals, brochures developed by KALRO and other stakeholders as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling;

F: Contacts	
Contacts	Centre Director KALRO Kabete
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr Jedidah M. Maina and Charity W. Muchira. Dr. Ruth Amata
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

Research Gaps:

Management of troublesome perennial grass weeds and sedges in AIVs.

6.6 Mechanization of AIVs Production Activities

11.6.1 TIMP Name	Power tiller
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIV commodity • Delayed operation lead to late planting • High cost of manual labour • Inconsistent land preparation
What is it? (TIMP description) Ploughing tractor 14HP  (source: KALRO-Katumani	A Power Tiller is a two-wheeled agricultural implement fitted with rotary tillers, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 1ha per day by one operator in about two hours. This will vary depending on the climatic conditions, soil types, soil moisture content, stamina and experience of the operator. Fuel consumption is about 15 liters per ha. Though these results varies with the technical ability of the operator.
Justification	It has multiple uses and other advantages. Power Tiller helps in preparing the soil, sowing seeds, planting seeds, spraying the fertilizers, herbicides and water. In addition to it also helps in pumping water, harvesting, weeding and transporting crops. A power Tiller is ideal where the land size is small. Farm sizes average less than one hectares which limit turning ability of conventional tractors while manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, cheap cost, multiple usage

Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of the machines • High initial cost for small-scale farmers to import or when fabricated.
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Power tiller is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment due to lack of finances due to limited access to credit facilities • AIVs Power tiller should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Power tiller increases participation of household members in working in AIVs farms that is women, men and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating power tiller is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the equipment

	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Power tillers need to be designed in such a way which would enable people abled differently to operate it • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, 0733812953
Partner organizations	Local Fabricators

11.6.8 TIMP name	**Wheeled Tractor less than 50Hp**
Category (i.e. technology, innovation ,or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIVs commodity • Drudgery and fatigue • Low output • Inefficiency and inconsistency of work. • Untimeliness • High cost of manual labour
What is it? (TIMP description)	A tractor is an engineering vehicle specifically designed to

	deliver a high tractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) tillage, trailer towing, planting, weeding, ridging, planting, spraying, harvesting, ground grading and much more agricultural functions. Agricultural implements may be towed behind, mounted behind or in front of the tractor and the tractor may also provide a source of power if the implement is mechanized. It is therefore fitted with various equipment at alternate times for easing farm operations
Justification	A Tractors is an essential necessity of farming as it provides machine power for performing farm applications. In addition to routine farm activities, it is efficient, timely, consistent, releases labour and reduces cost as compared to manual labour. With a small horse power of 50, it is affordable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the tractors • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying a tractor • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and	Organized producers' groups to ensure consistence

market conditions necessary for upscaling	availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Tractor – KES 1,500,000 Plough – KES 350,000 Harrow – KES 400,000
Estimated returns	2ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• The wheeled Tractor less than 50Hp is can be used by all • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities such as Wheeled Tractor less than 50Hp • Men dominate most decisions at the household and community levels hence they make decisions relating to land preparation for AIVs and also on equipment to be used in the farms • AIVs farming machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • The is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	• Creates employment especially for women and youth • Reduces drudgery for women farmers as well as men • Promotes inclusivity of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating Wheeled Tractor less than 50Hp is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not know where to get such tractors • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to purchase the tractor since it is affordable and easy to maintain machines
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs • Promotes inclusivity of all genders
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level

Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Traders, Processors

11.6.9 TIMP name	**Mould board plough**
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Unbroken heavy clods in the soil and gives it an uneven structure. • Uneven plough depth • Requirement of added weight for ballasting by disc plough.
What is it? (TIMP description)  Source; captain tractors pvt. Ltd	Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation. The plough conserves moisture and biomass while pulverizing the soil hence climate smart.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is Versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.

Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Kirinyaga, Murang'a
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying the plough • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials • Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Plough – KES 380,000
Estimated returns	5 year working
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in their farms • Mouldboard plough can be used by all genders including women • Mould board plough AIVs equipment is expensive for women to purchase • AIVs farming machines should be designed for easy start and operation by all gender. • There is need to equip women, youth and stakeholders with information relating to the Mould board plough • Linking the women and youth to financial institutions would enable them to buy since it is affordable and easy to maintain machines
Gender related opportunities	• Creates employment especially for youth

	• Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating mouldboard plough is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence might not be aware of mould board plough • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMGs
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology can be easily utilized by all gender categories (especially women and youth)
Gender related opportunities	• It offers good opportunity for commercial venture that can empower all gender categories
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology can be easily utilized by all VMGs
VMG related opportunities	Offers opportunities for lucrative commercial venture by VMGs
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.10TIMP name	Disc Harrow
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in a commercialized AIVs commodity • Difficult to break clods manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)  Source; https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.sv	A harrow, farm implement used to pulverize soil, break up crop residues, uproot weeds and cover seed. It is a farm implement used for surface tillage. It is used after ploughing for breaking up and smoothing out the surface of the soil. The purpose of harrowing is to break up clods and to provide a smooth soil structure, called tilth, that is suitable for planting seeds. Coarser harrowing may also be used to remove weeds and to cover seed after sowing.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines

Suggestions for addressing the challenges	• Produce profitably to generate money for buying the harrow • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials • Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Harrow – KES 350,000
Estimated returns	3 year working
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Disk Harrow can be used by all genders but it is expensive to purchase by stakeholders especially by women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels hence determines the type of equipment to be used in AIV farms • AIVs cultivation is associated with women although some productive resources are owned by men such as farm equipment this being the men might not purchase the disk harrow since they have no interest in AIVs • There is need to equip women, youth and stakeholders with information relating to the AIVs disk harrow
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating a disk harrow is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not be aware of the existence of a disk harrow and how it is operated • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Farm machines need to be designed in such a way which would enable people able differently to operate

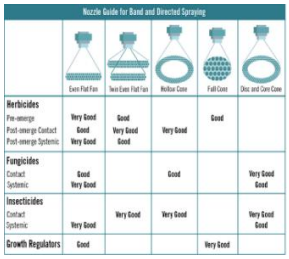
	• In addition they need to be affordability and easy to maintain machines for all types of farmers
VMGs opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMG farmers
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.11TIMP Name	**AIV Planter**
Category (i.e. technology, innovation or management practice)	Innovations
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of planting, in the commercialized AIV commodity. High seedling density hence need for labour in thinning. High cost of Manual labour .
What is it? (TIMP description) 	A seed drill is a farm implement that sow seeds at a desired seeding rate and depth, ensuring that the seeds are covered and compacted under soil. This saves them from being eaten by birds and animals, or being dried up due to exposure to sun. With seed drill machines, seeds are distributed in rows, however the distance between seeds along the row can be adjusted by the user. This allows plants to get sufficient sunlight, nutrients, and water from the soil. A Seed Drill is designed to provide the flexibility to configure the planter to suit your requirements. Features including powder coated large capacity seed and fertilizer boxes which can sow a large range of seeds and fertilizers from both boxes. The seeding/fertilizer rate can be infinitely varied simply by moving a lever. The boxes also have a clean out plate for easy clean out.
Justification	To make AIVs production activities less tedious and more effective. Attract the youth to agribusiness through operation of

	the machines. Before the introduction of the seed drill, most seeds were planted by hand broadcasting, an imprecise and wasteful process with a poor distribution of seeds and low productivity. Use of a seed drill can improve the ratio of crop yield (seeds harvested per seed planted) by as much as nine times Sikander et al., 2003.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up and their roles	KALRO, universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • Lack of capacity for small-scale farmers to purchase
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if any	• Mechanization in agriculture increases production through efficient operations • Timely planting
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	485,000.00
Estimated returns	5ha/hr
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIV planter is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment as they lack finances due to limited access to credit facilities • Women have limited access to agricultural information and extension services hence they might not be aware of the existence of the AIV planter • AIV planter should be designed for easy start and operation by all gender.

	• Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • AIVs planter increases participation of household members in working in AIVs farms that is women, men and youth • Adoption of AIV planter reduces loses incurred due to poor planting of AIVs reading to some being eaten by birds and others being burnet by the sun
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating AIV planter might be complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the AIV planter • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • AIV planters need to be designed in such a way which would enable people abled differently to operate • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs • Reduces losses incurred during planting of AIVs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires	Requires further research
further research)	
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone:

	0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.12TIMP Name	**Motorized Sprayer**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of planting, in the commercialized AIVs commodity • High seedling density hence need for labour in thinning
What is it? (TIMP description)   (Source; Nasirembe, Katumani, 2021)	A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides and fertilizers on agricultural crops Sprayers are man-portable units typically backpacks with spray guns They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron e.g. as well as foliar fertilizers.
What is it? (TIMP description)	Pest reduce yields up to 98% and are a major menace in agricultural production. Before AIVs forms a canopy, broad leafed weeds compete with Cabbage seedling for nutrients and light greatly reducing their yield. A manual sprayer is labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency
Justification	To make AIV production activities less tedious and more effective. Attract the youth to agribusiness through operation of the machines. With a motorized knapsack, a farmer is able to spray 4 times more in a day compared to the manual one. The farmer can also use the sprayer to spray livestock to control pests
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up	KALRO, Universities for information

and their roles	Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • High cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	Local fabrication of affordable AIV production machines
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer – KES 56,000
Estimated returns	0.5ha /hour
Gender issues and concerns in development, dissemination, adoption and scaling up	• Motorized sprayer is designed for easy start and operation . • Women and youth have limited finances to pay services and to purchase farm equipment such AIVs motorised sprayer due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization hence might not be aware of the existence of motorised sprayer • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • With the introduction of motorised sprayer men have been drawn weeding in AIVs farms, weeding was predominantly done by women before the introduction of the machine.
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It promote gender inclusivity reducing the work load for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities Operating a motorized sprayer is complex for some VMGs especially those who are abled differently • AIVs machines need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable

VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs farmers • It promote productivity hence providing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as Maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.13TIMP Name	**Power weeder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIV • Quality of leaf
What is it? (TIMP description)  (Source: Shakti Industries)	Power weeder is a device used for removing the weeds, stirring and pulverizing the soil and for loosening the soil after the crop has begun to grow. It is a self-propelled power weeder with a fully functional gear box having one forward and reverse gear transmission with clutch. It is suited for small and large scale AIVs farmers

	weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make AIV weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. Hand weeding is tedious and time consuming while manual operations are timewasting and expensive.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIV knapsack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares

	Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs power weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs power weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs power weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the TIMP • AIVs power weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs power weeder due to limited access to credit facilities • Operating a AIVs power weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP • AIVs power weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Ready for up-scaling

G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.14TIMP Name	Back Pack Weeder
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIVs • Quality of leaf
What is it? (TIMP description) 	It is a hand held machine that simultaneously cut the soil and weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make AIVs weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	

Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local Industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs Back Pack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs back pack weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs back pack weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs back pack weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the AIV back pack weeder • AIVs back pack weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs back pack weeder due to limited access to credit facilities

	• Operating a AIVs back pack weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP • AIVs back pack weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953

TIMP Name	**Back AIVs Harvester**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of Manual weeding and winnowing of AIV Quality of leaf
What is it? (TIMP description)  (Source:https://www.alibaba.com/product-detail/Convolvulus-harvester-spinach-	It is a hand held machine that simultaneously cut the vegetable leaves and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to harvest specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc. It runs on electricity not to contaminate the crop. Electric motor drive, no pollution, low labour intensity. Has a wide and flat cutting table, Independent unit control for cutting and walking conveyer, easy to operate; With High efficiency, cutting, transportation, collection in one machine and can harvest multiple vegetables, for example:

harvester-and-Leaf_1600070046703.html?spm=a2700.7724857.0.0.141c1e66be7uVP)	
Justification	To make AIVs weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs harvester KES 597,600 per unit
Estimated returns	• Capacity 0.25ha/ hour, 0.003kW /hr Harvesting charges: KES 1,600 per hectare
Gender issues and concerns in development and dissemination	• Back AIVs harvester can be used by all genders but it is expensive for AIVs to afford especially women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm equipment such as back AIVs harvester

	• Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in harvesting AIVs • Back AIVs harvester should be designed for easy start and operation. • There is need of up-scaling back AIVs harvesters and all the genders should be targeted
Gender related opportunities	• Reduced labour intensity in harvesting • High productivity is increased leading to increased food security and nutrition • Creates employment especially for women and youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as Back AIVs harvesters due to limited access to credit facilities • Operating a Back AIVs harvester is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the Back AIVs harvester • Linking the VMG to financial institutions would enable them to buy Back AIVs harvester since it is affordable and easy to maintain machines • Back AIVs harvesters need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• Reduced labour intensity in harvesting for VMGs • High productivity which leads to increased food security and nutrition • Creates employment for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIVs contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Require validation
S validation	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535

Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors
Partner organizations	JKUAT, MOA, Tractor hire service contractors

6.7 Jute Mallow Postharvest Handling

2.8.1 TIMP Name	**Jute mallow Sorting and Grading**
Category (i.e. technology, innovation or management practice	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inferior quality and low prices from unsorted vegetables
What is it? (TIMP description)	• Sorting is done to remove diseased vegetables, vegetables with yellowing spots, weeds and debris. • Grading is categorization of vegetables according to leaf size, weight, maturity, turgidity, physical damage, and market demand 
Justification	Sorting helps to eliminate vegetables of poor quality and prevent cross contamination between infected and healthy vegetables. Vegetables of superior quality fetch higher prices in the market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increasing awareness on the benefits of sorting and grading among value chain actors, postharvest trainers, well-organised farmer groups
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling and value addition of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on vegetable postharvest handling • Green grocers and vegetable sellers • Supermarkets and institutions (e.g. schools and hospitals) - will provide markets for vegetables
C: Current situation and future scaling up	

Counties where already promoted if any	Vihiga, Busia, Kakamega
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of premium price for quality vegetables discourages farmers and traders to adopt sorting and grading management practice
Suggestions for addressing the challenges	Access to markets that appreciate good prices and have better prices
Lessons learned in up scaling if any	Promote utilization of dried jute mallow vegetables
Social, environmental, policy and market conditions necessary for development and up scaling	• Access niche marketing for the different quality of produce • Producers and traders are willing to adopt the management practice • Food safety issues are considered while applying the management practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	No cost
Estimated returns	Sorting and grading translates to high quality, which fetches higher income.
Gender issues and concerns in development dissemination, adoption and upscaling	• Sorting and Grading of jute mallow is usually done by women increasing their labor. It is easily adoptable after training and many farmers can use the technology since it reduces losses incurred after harvesting and increases income. • Women have less access to information on jute mallow packaging • Women and do most of the work within the jute mallow value chain but the funds are controlled by men hence they have no funds to pay the workers • The management practice are easily applicable hence farmers can easily learn them.
Gender related opportunities	• There is reduced Jute mallow post- harvest losses • Creates employment for women and the youth • Increases income for women and the youth • There is increased food security and nutrition for household
VMG issues and concerns in development, dissemination, adoption and upscaling	• Sorting and grading of jute mallow is labor intensive for some VMGs to undertake • VMGs have limited finances to pay labor services due to limited access to credit facilities • VMGs have limited access to agricultural information and extension services hence they might not be aware of the importance of sorting and grading
VMG related opportunities	• The technology will create jobs hence source of income for VMGs

	• The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • There improved food security and nutrition for VMGs • VMG have limited access to training and education on the fruit packaging
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Indigenous vegetables collection centres in Busia county
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:
None

2.8.1 TIMP Name	**Zero Energy Brick Cooler**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses (30%) caused by lack of cooling technologies for vegetables
What is it? (TIMP description)	The Zero Energy Brick Cooler consist of a double brick wall filled with sand in between, and a storage chamber. The sand is kept moist with water. The inside chamber is cooled through of the water in the sand.

	
Justification	Appropriate cooling reduces postharvest losses and extends shelf-life
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, green grocers, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The sand should be continuously moist. Cooling is more effective in dry and windy environment
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowledge on ZECC
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Kirinyaga
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of starter capital to construct the cooler
Suggestions for addressing the challenges	Avail appropriate financing Organize farmers into groups who aggregate produce and ZECC is installed
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	• Willingness of farmers to adopt the technology • Create niche market where producers fetches better prices • Cooling ensures that food safety issues are addressed
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware ZECC jute mallow storage due to limited access to agricultural information and technology

	• The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for jute mallow storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the ZECC
Gender related opportunities	• There will be increased shelf life of jute mallow • There will be increased employment opportunities for the youth and women at various nodes of jute mallow value chain • There will be stable supply of jute mallow for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of Jute mallow • There will be stable supplies of jute mallow for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. have used the technology to reduce losses and extend shelf-life, hence the marketing time for the vegetables.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683

Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

- Optimising the storage conditions and keeping quality of the different vegetables.
- Validate the technology in difference AEZs.
- Research on innovative investment options for farmers and groups.

2.8.1 TIMP Name	**CoolBot™**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of appropriate cooling technologies for vegetables
What is it? (TIMP description) 	It is a low cost postharvest temperature management that improved the shelf life of banana using less power The Coolbot™ is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lesser cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as 4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.
Justification	CoolBot provides inexpensive, effective cooling. Appropriate cooling reduces postharvest losses and extends shelf-life for consumption and marketing. Farmers who can store their produce longer can take advantage of better prices, as market prices can fluctuate dramatically over time.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension workers, women and youth groups, aggregators, traders, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increase postharvest training and direct farmer outreach
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot™ Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira

Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling vegetables. • Limited awareness of the technology by farmers • Inadequate funds to install the Coolbot™
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up scaling	• Willingness of farmers to adopt the technology • Create niche market where producers fetches better prices • Cooling ensures that food safety issues are addressed
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• CoolBot (US$ 300) • Air conditioner • Insulated room • Monthly electricity costs
Estimated returns	• Better returns since postharvest losses are reduced
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware CoolBotTM jute mallow storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for jute mallow storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the CoolBot™
Gender related opportunities	• There will be increased shelf life of jute mallow • There will be increased employment opportunities for the youth and women at various nodes of jute mallow value chain

	• There will be stable supply of jute mallow for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of jute mallow • There will be stable supplies of jute mallow for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories	- Fruit and vegetable farmers in Embu, Kirinyaga, etc. - **Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre** to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guideline for users	CoolBot™ factsheets, brochures and manuals available from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:

- Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the CoolBot™.
- Gross margins of the Coolbot™

2.8.1 TIMP Name	Wakati™ technology
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to limited cooling technologies
What is it? (TIMP description) 	-Wakati™ is a simple and innovative solution where altered environment in the chamber contributes to shelf life extension -Altered environment is due to: - High relative humidity - Oxidation of ethylene from the storage environment by oxidizing (ozone oxidation) It is a 1m by 1m canvas tent with a solar powered fan t one corner. The fan is placed in a cuplike reservoir. As it rotates, it picks up water into mist droplets, which are distributed in the tent by air currents. When a moisture concentration of 80% is achieved, the surface of the fruit or vegetables remain fresh because there is no loss of water. This low-cost solution helps produce last up to 10 times longer without any refrigeration.
Justification	Appropriate cooling reduces postharvest losses. The technology increases the length of time vegetables can be stored without refrigeration, gives farmers more time to sell. The climate control approach used by Wakati™ is affordable and clean technology.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh vegetables (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The optimal use of Wakati™ One is outside, in a warm and dry climate. Apart from a small amount of water— around 1L of water a week—it does not require any extra resources. The product does not need a power grid, it works on solar energy.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on Wakati™ Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooing vegetables. • Limited awareness of the technology by farmers

	• Inadequate funds to install the Wakati™
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	Due to limited funds to install the technology, farmers are organized together and develop aggregation centre
Social, environmental, policy and market conditions necessary for development and up scaling	• Willingness of farmers to adopt the technology • Create niche market where producers fetches better prices • Cooling ensures that food safety issues are addressed
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware Wakati™ technology jute mallow storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for jute mallow storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the Wakati™ technology
Gender related opportunities	• There will be increased shelf life of jute mallow • There will be increased employment opportunities for the youth and women at various nodes of jute mallow value chain • There will be stable supply of jute mallow for markets and food in families
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to due to lack of access to credit facilities hence they might not be able to adopt Wakati™ technology • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. So they might not be aware of the Wakati™ technology
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercialization of jute mallow • There will be stable supplies of Jute mallow for the markets and for food for VMGs

	• Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

6.8 Jute Mallow Value Addition

2.8.1 TIMP Name	**Jute mallow solar drying**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Jute mallow has short shelf life contributing to postharvest losses
What is it? (TIMP description)	Drying of jute mallow removes excess water thus extending their shelf leading to reduced postharvest losses 
Justification	Jute mallow has short shelf life due to high perishability. Drying prolong its shelf life and reduce postharvest losses.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, consumers, women and youth groups
Approaches used in dissemination	Practical demonstrations, field days
Critical/essential factors for successful promotion	• Create awareness on utilization of dried jute mallow • Successful in areas with good solar radiation • Local artisans can be trained on fabrication, repair and maintenance • Ensuring sanitary condition when handling vegetables for drying
Partners/stakeholders for scaling up and their roles	Famers- to adopt the technology for usage Artisans - to fabricate the solar dryers Agricultural extension workers- to provide farmers with knowhow on solar drying of vegetables, and utilization of solar dried vegetables
C: Current situation and future scaling up	
Counties where already promoted if any	Isiolo, Kakamega
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of funds to acquire the solar dryers • Challenges in repair and maintenance
Suggestions for addressing the challenges	• Sensitization of the community about high health and nutrition benefits of solar dried vegetables • Provide loans / capital to farmers groups to acquire the solar dryers • Capacity building of local artisans on repair and maintenance
Lessons learned in up scaling if any	Consumers are trained on utilization of dried vegetables
Social, environmental, policy and market conditions necessary for development and up scaling	• Solar dried vegetables can be used during the dry season • Producers and traders are willing to adopt the technology • Access to new markets that can absorbs the dried products • Farmers are able to produce enough quantity to dry the vegetable
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cabinet solar drier costs approximately KES 20,000/-
Estimated returns	Increased income, nutrition Reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	• Jutemallow cultivation is mainly done by women who have limited access to agricultural information and extension services so they might not be aware of jute mallow solar dryer • Women lack finances due to limited credit facilities so they might not be able to purchase jute mallow solar dryer • Most decisions relating to purchasing of farm equipment are made by men who have no interest in jute mallow value chain hence they might not purchase the dryer
Gender related opportunities	• The TIMP increases farm income through reduction of postharvest losses

	• Adoption of Jute mallow solar dryer enhances food security and nutrition for households
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs lacks access to information on new technologies and information so they might not be aware of Jute mallow solar dryer • VMGs have no finances due to limited access to credit facilities to purchase jute mallow solar dryer • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the jute mallow solar dryer means reduced postharvest losses and enhanced food safety for VMGs • The TIMP has the potential of prolonging shelf life of pumpkins leading to improving food and nutrition security and a window for increased income for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guideline for users	Solar drying guidelines and brochures from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation.
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Machakos Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Research Gaps

4. Limited information on success stories of AIVs.
5. Cultural issues in participation in some AIVs species value chains
6. Low information on profitability of AIVs in the project areas

6.9 Farming Business and Marketing Of Jute Mallow

TIMP Name	**Transformative Model of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Most of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers have small production units with limited use of improved inputs. This leads to low African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine productivity. Low productivity leads to poor market access, .
What is it? (TIMP description)	An approach to transform smallholder farmers from low improved inputs to high and therefore build market linkages. At the fully commercial level, inputs are accessed from the markets and outputs solely for the markets.
Justification	Market failures or missing markets of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine have led to disorganization in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Due to the disorganization in production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, smallholder farmers fail to access markets or have limited market linkages. Therefore, this model aims at linking farmers to markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, Universities, policy makers
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of traders and other upstream actors • Acceptance of smallholder farmers to form production organizations • Investments in the production of quality tradable volumes • Acceptance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties by consumers • Adaptability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties • Prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Availability of storage infrastructure and transport

Partners/stakeholders for scaling up and their roles	• Farmers – Formation of production groups, investments in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local traders and exporters) – Support in input services and providing markets for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties • Group dynamics • Lack of seeds • Weak or non-existent stakeholder innovation platforms • Fluctuations in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices • Levels of production constraints • Level of policy support • Poor and week linkage
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production farmer groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming. Improved productivity • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties – Use of promotion channels for instance meetings, stakeholder forums, media, demonstrations and field days

	• Group dynamics – Capacity building of the groups on group dynamics and management • Limited supply of demanded seed varieties – Engagement seed companies. • Capacity building of farmers on seed production • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Low and fluctuating African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices - Value addition, organized marketing channels, producer organizations, capacity building on the reduction of production costs, capacity building on farming as a business • Levels of production constraints – improving credit accessibility, enhancing adoption of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine TIMPs • Level of policy support – Lobbying for the County government support in policy formulations
Lessons learned in up scaling if any	• There is need to have an all inclusive enhance value addition in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to increase profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability by the farmers, group dynamics, cultures to have value added products • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), • infrastructure, investment environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000

Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Different acceptance characteristics by youth, females and males. Gender roles in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. Availability of technologies for pre-harvesting, harvesting and post-harvesting • Adoption and scaling – Different acceptance characteristics, Gender inclusion in the formation of producer organizations.
Gender related opportunities	• Production opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Emerging mechanization in the value chain • Generation of income by youth female and male
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited involvement of VMGs in the market linking models • Adoption and scaling up - Limited access to seed and information on production techniques
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generation using farmer-market linking arrangements • Access to inputs and markets through linkages and producer organization
E: Case studies/profiles of success stories	
Success stories from previous similar projects	High yielding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine hybrid seed bought by the county government of Marsabit and other counties
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294

Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Evaluating efficiency of the farmer-market linking and business models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Building a Business Plan for African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Unplanned and traditional production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine leads to lack of production targets, losses and market failure, leading to low productivity.
What is it? (TIMP description)	A business plan is a document guides the operations in a business. The document contains details susch as introduction, business organization, product, marketing strategy, risks, business operation plan, marketing costs, Income streams, profit and loss analysis and financial requirements
Justification	A Business without a plan cannot identify its strenths, weaknesses, opportunities and threats. Guided by a business plan, farmers will not analyse opportunities, explore options, select the best option, detailed planning and implementation. There are many opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, processing and marketing. However, the achievement of the best opportunity would depend on the analysis of strength, weaknesses and threats.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, NGOs, Extension agents, policy makers and implementers
Approaches to be used in dissemination	Trainings, factsheets, manuals

Critical/essential factors for successful promotion	• Education levels of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farmers and other actors • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Supporting policies and regulations
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding opportunities • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders, processors and exporters) – Demanding opportunities • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub

	• Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Sensitization of stakeholders the challenges • Level of policy support – support in extension services
Lessons learned in up scaling if any	Need to address the challenges in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to enhance benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming in the climate change situations • Environmental conditions – Use of opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Marketing opportunities for youth, men and females • Adoption and scaling – Harmonizing opportunities
Gender related opportunities	Production and marketing opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited opportunities • Adoption and scaling up – Comparisons of opportunities and weaknesses at the level of VMGs
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generating opportunities for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Utilization of Amaranth in Kitui, Machakos and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides are available

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the SWOT matrix
- Efficiency in identifying the opportunities
- Performance of the opportunities

TIMP Name	**Profitability analysis**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The problem of failure of profitability analysis is common among the smallholder farmers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. This leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise in terms of low productivity and income
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain, leading to low productivity
Justification	Profitability analysis reviews the management success and sustainability of the Finger millet business. It indicates areas of adjustment .
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, policy makers

Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	• Production programme • Availability of data on quantities of inputs requirements, costs, outputs and value
Partners/stakeholders for scaling up and their roles	• Farmers – Defining production programme • County extension staff - Capacity building • NGOs – Capacity building • Research – Cost-benefit analysis
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and Marketing • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Level of policy support – support in extension services
Lessons learned in up scaling if any	Majority of farmers do not keep records

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Environmental conditions – Opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Poor record keeping, low income, low engagement in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Adoption and scaling – Involvement of youth, females and males
Gender related opportunities	Implementation of production and marketing opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – African night shade, • Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production Programmes for VMGs • Adoption and scaling up – Levels of profitability
VMG related opportunities	• Production opportunities – African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production programmes • Profitable opportunities like production, processing
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos

	cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the budgets
- Profitable opportunities
- Effects of record keeping

TIMP Name	**Marketing Innovation model for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine Production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	As farmers produce and market African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, they fail to follow business principles including marketing strategies in farm operations and farm activities geared toward making a profit
What is it? (TIMP description)	Production and marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit. An entrepreneur farmer undertakes innovations and finances business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of finger millet, the market outlook will be narrow. Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles in farming leads to unsuccessful.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers., traders
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT

Critical/essential factors for successful promotion	• Organization of farmers • Availability of innovations • Achievement of profit • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	• Farmers – Acceptability of innovations • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders, processors, and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Small-scale farming • Availability of information • Profitability in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farming • Levels of policy support
Suggestions for addressing the challenges	• Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional methods • Environmental conditions – Use of pesticides and disposal • Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000

Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the innovations adoption • Adoption and scaling – Differentiated innovations for instance spraying by females is difficult. Youth is normally engaged
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the innovations adoption • Adoption and scaling up – Capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs leading to improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Efficacy and suitability of various chemicals
- Sustainability based on market prices
- Innovations for the increased productivity

TIMP Name	**Collective marketing**
Category (i.e. technology, innovation or management practice)	**Management practice**

A: Description of the technology, innovation or management practice	
Problem addressed	Low productive leading to lack of bargaining power and volumes for sale
What is it? (TIMP description)	A marketing or producer organizations formed by farmers
Justification	Poor farmers in many remote areas do not understand how the market works or why prices fluctuate; they have little or no information on market conditions, prices and quality of goods; they are not organized collectively; and they have no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market. Difficult market access restricts opportunities for income generation. Farmer organization provides relevant data to help solve marketing challenges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Barazas, Trainings, Factsheets, Manuals, Field days, ICT, Radio.
Critical/essential factors for successful promotion	• Organization of farmers • Availability of facilitators • Availability of many traders • Production volume and quality • Trust • Innovativeness
Partners/stakeholders for scaling up and their roles	• Farmers – Organization of groups • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators • County government – Policy support
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Availability of information • Levels of policy support

Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organization • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming, improved productivity • Availability of information – Capacity building of producer groups • Policy support – Engagement with the county government
Lessons learned in up scaling if any	Reduction of transaction costs leading to increased profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented • Environmental conditions – Depleted soil nutrients due over-use of cultivated land and pollution due to use of pesticides • Policy conditions – Available policy support
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the marketing organization committee • Adoption and scaling – Inclusion of youth, males and females in capacity building
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the formation of marketing organization • Adoption and scaling up – Consideration of VMGs during capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None

Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of marketing organization
- Sustainability of the management of the organization
- Equity distribution in sales and income

TIMP Name	**Contracted production**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Markets failure in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves private companies extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.

Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension, research institutions, farmer cooperative societies
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Production volume • Enforcement and bidding contract farming
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff - Capacity building, signing contract • NGOs – Capacity building • Private sector (local traders and exporters) – Contract party and beneficiaries • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira

Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Lack of information by part of the producers • Level of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – Increase volume through increase in productivity • Lack of information by part of the producers – Capacity building • Level of policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming • Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management • Policy conditions– Policy in formulation and enforcement • Market conditions – volume, place, price, promotion, traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in signing of the contract • Adoption and scaling – Equity distribution of income based on contract farming
Gender related opportunities	Market access, increased income, improved livelihood
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building • VMGs • Adoption and scaling up – Participation in signing contract farming
VMG related opportunities	Market access, increased income, improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of contracted farming in terms of productivity, sales and profit
- Equity distribution
- Improvement in skill and information delivery

TIMP Name	**Digital marketing**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Poor market access due to constraints in marketing channels, skills and market information leading to low productivity
What is it? (TIMP description)	Internet marketing refers to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals

Critical/essential factors for successful promotion	• Education levels of the farmers and investors in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and profitability analysis • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of african night shade, amaranth, spider plant, slender leaf, cowpea, jute mallow and pumpkine • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization

Lessons learned in up scaling if any	• Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – low levels of adoption of information technology • Environmental conditions– improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Capacity building in digital skills for the youth, men and females • Adoption and scaling – Capacity building on benefits of digital marketing skills for the youth, men and females
Gender related opportunities	Improved accessibility of information duel to availability of mobile phones by youth, males and females
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building on digital skills • Adoption and scaling up – Capacity building on benefits of digital marketing skills for the VMGs
VMG related opportunities	Improved accessibility of information duel to availability of mobile phones by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Levels of digital skills by farmers
- Performance of the internet marketing in terms of productivity, sales and profitability

TIMP Name	**Market research**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Farmers' lack of market information on outlets and prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
What is it? (TIMP description)	A approach by farmers to gather market information
Justification	The rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore participatory market research will assist farmer to gain knowledge on the structure and performance of markets leading to higher profit.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media, ICT
Critical/essential factors for successful promotion	• Availability of County policies • Willingness of farmers • Availability of targeted markets • Access to markets
Partners/stakeholders for scaling up and their roles	• Farmers – participants in market research • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine -byproducts market outlets. • Lack of skills in the use of communication technologies • Group dynamics • Policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Organization of producer groups for cooperate marketing. • Small-scale farming – Increase hectarage under African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, improving productivity and aggregation of produce to achieve large volume for the market • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Capacity building on sources of information. • Group dynamics – Capacity building • Policy support – Support in extension services
Lessons learned in up scaling if any	Improved marketing strategies
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Level of education of the community • Environmental conditions – Farmers are in different geographical localities • Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – Existing demand
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in the participatory market research • Adoption and scaling – Capacity building youth, males and females
Gender related opportunities	Increased production and marketing opportunities by youth, females and males.

VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the participatory market research • Adoption and scaling up – Capacity build VMGs
VMG related opportunities	Increased production and marketing opportunities for the VMGs leading to higher income
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Barazas, training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of participatory market research process
- Production and marketing efficiency in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine due to the participatory market research process
- Equity distribution in income and change in livelihood

6.10Agricultural Policy Options

TIMP Name	**Advocacy in farmers' participation in the National Agricultural Policy development and implementation**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provide objectives

What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provides objectives.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter,email), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine-based policies
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira

Challenges in development and dissemination -	• Value Chain: African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • Standards: Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, wherein many farmers abandoned African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. These weak organizations provide few services to farmers while providing limited bargaining power. • Financial Incentives: The government provides only limited support to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs).
	Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.

Suggestions for addressing the challenges	• Value Chain: Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors. • Standards: Existing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training. • Aggregation: Partnerships between farmer cooperatives and African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs. • Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine where there is no value chain • Environmental conditions – Use of pesticides • Policy conditions – Lacking specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Supporting youth, females and males in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling – Supporting youth, females and males in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
Gender related opportunities	• Providing incentives to youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling up - Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
VMG related opportunities	• Providing incentives to VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294

Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Participation in the County Integrated Development Planning**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Poor performance of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine sub-sector in Marsabit county leading to low African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production/ productivity and income
What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Finger millet production, marketing and processing are considered. ..
Justification	Agriculture is the main economic activity in Marsabit County. The county is Kenya's largest producer of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, producing approximately 40%. This has significant implications on income generation, food security and poverty reduction efforts in the county. Therefore African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine is a major cash crop considered in the Marsabit county integrated development plan (CIDP). Smallholder farmers' failure to participate during the planning of the County Integrated Development would lead to omission in the development funding and implementation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups

Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders Universities
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the
	community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The project offers support to all categories of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers including the VMGs
Application guidelines for users	Training factsheets, manuals and power point slides

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Ready for up scaling
Lead organization and scientists	
Partner organizations	

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	The existing policy instruments do not centralize the smallholder farmers' issues in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Therefore, weak policy instruments lead to market failure for both inputs and outputs
What is it? (TIMP description)	Agricultural policy is implemented through instruments which are the intervention points. Therefore, the policy instruments are the means to achieve policy objectives
Justification	Without policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, farmers will remain without support in the agro-enterprise and market development. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability may lack centralization of the smallholder farmers agency and voices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups

Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders • Universities - sensitization
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Nutritional project implemented in Machakos, Kitui and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up
G: Contacts	

Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy cycle**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy leading to low productivity due to low adoption of quality inputs and poor marketing channels
What is it? (TIMP description)	Policy cycle involves problem definition or concerns, formulation, implementation and evaluation components
Justification	Policy cycle is used in the formulation and implementation of agricultural policies for the agriculture and rural development. Due to lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy, policy cycle can be used in the formulation and implementation and evaluation of outcome. African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain has specific policy concerns which can be identified at the stage of problem definition in the policy cycle. The issues are addressed at the implementation stage. As the implementation goes on, there is need for an evaluation at the evaluation stage to determine the success of the policy. The cycle completes by the establishing of the failure in to achievement the objectives or goals of the development agenda.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Public participation meetings
Critical/essential factors for successful promotion	• Availability of stakeholders • African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy concerns • Level of understanding of stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • County extension staff - sensitization of stakeholders
	• NGOs – sensitization of stakeholders • Private sector (local traders and exporters) – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Research institutions – sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of spearheading in the policy formulation • Lack of organized forums • Inadequate information to stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain
Suggestions for addressing the challenges	• Lack of spearheading in the policy formulation – the agricultural department in the county should take the initiative to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is in place • Lack of organized forums - formation of stakeholder forums consisting of well-informed participants. • Inadequate information to stakeholders – sensitization of stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain – active participation by the actors in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain.

Lessons learned in up scaling if any	For the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry to progress, there is need for a African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – social inclusion • Environmental conditions – environmental conservation strategies to be highlighted in the policy • Policy conditions – to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is formulated and implemented • Market conditions – within the policy framework
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting youth, females and males in the production • and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – The policy should facilitate the benefits to vulnerable and marginalized groups • Adoption and scaling up - The policy should facilitate the benefits to vulnerable and marginalized groups
VMG related opportunities	• People with Disability will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income of VMGs

	• Increased employment of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers 3 Farmer accessibility to production inputs.
- Sustainability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry

6.11 Good Agricultural Practices and Food Safety Management System Jute Mallow

TIMPs name	**Good Agricultural Practices (GAP**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Detection of food contaminants in both fresh produce, including AIV's, has been rampant. This results in declining food safety and quality, therefore frustrating sustainable farming of these crops for both food and income generation. Most markets continue to impose more stringent measures (to ensure the safety of consumers) for those wishing to access the said markets. These contaminants also impact negatively on the environment, worker safety and health; and consequently making it difficult to implement traceability, as

	most producers do not give accurate information on inputs and processes used during production, to avoid commercial losses and even prosecution
What is it? (TIMP description)	It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards (It is not about a specific crop production, but the process through which production takes). The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. Commercialization of AIV's on the domestic and future export level highly depends on compliance to these market standards
Justification	There is need to arrest the rampant detection of food contaminants in AIV's. Good Agricultural Practice(s) (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture [by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM)] to continuously improve farming systems. GAP is of utmost importance in protecting consumer health by ensuring safety throughout the food chain. It needs to be enforced and transparent, not only from the table but also upstream to include suppliers (e.g. quality of fertilizers and plant protection products) and all t h e value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support from government particularly the enforcement of KS1758 (a domestic scope standard that has been passed after undergoing public participation stage).
Partners/stakeholders for scaling up and their roles	Producer organizations (FPEAK, FPC, KFC, AGAK etc), NGO's, MOALID, Private extension providers, CoG, and other value chain players

C: Current situation and future scaling up	
Counties where already promoted, if any	Already promoted in Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasingishu, Nakuru, Kericho, Bomet and other horticultural hot spots
Counties where TIMP will be up scaled	All counties in Kenya particularly where AIV's is grown
Challenges in dissemination	• Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Difficult to put monetary gains figures as most involves social and welfare issues in addition than markets lost due to non-compliance
Estimated returns	Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have less access to factors of production like land and credit • In most households, it is the men who make decision on what to do and how it is done ▪ Women may not have time and mobility to attend trainings and other extension activities far from home or held at times when they are performing other domestic roles ▪ Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles ▪ Women might not be aware of GAPs due to their low level of education and the social economic status ▪ There is need for all the stakeholders to be sensitized in GAPs to achieve good profits from their AIV's products
Gender related opportunities	• Agro-enterprise development by youth, females and males based on GAPs • Increased income due to improved income as a result of using GAPs by the youth, females and males

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to GAPs as they are not given chances to participate in agricultural trainings and workshops • VMGs have less access to farmer organization • VMGs have less access to farm implements VMGs have limited access credit to purchase the required GAPs • VMGs have limited access to training on GAPs and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination of GAPs • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Agro-enterprise development by VMGs based on GAPs • Increased income due to improved yield because of using GAPs, market access for the VMGs • Increased employment for VMGs and improved food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Small, holders in groups in the counties of Kirinyaga, Nyeri, Meru, Nakuru and other counties have been able to produce and export produce from horticultural crops that are certified after adopting and complying with GAP's.
Application guidelines for users	• Global GAP Version 6 (Code Ref: IFA V5.2_Feb19; English Version Versionn /Edition Update Register Page: 45 of 45) - https://www.globalgap.org/.content/.galleries/documents • KALRO-USAID Training And Extension Manual On Good Agricultural Practices (Gap) - Nov. 2017
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	• Director, KALRO Seed –Thika; info.ptc@kalro.org • Centre Directors; KALRO Kandara, • KALRO NSRC; • Director General KALRO
Lead organization and scientists	KALRO: Nyaga A., Ndungu J., Gatambia E., Kambo C., Kuria, S Musyoki R. Wasilwa, L., Kirigua, V., Muriuki SJN.
Partner organizations and their roles	MoALF&I, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's, Universities

TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for AIV's Value Chain in Kenya**

Category(i.e. technology, Innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The presence of chemical, biological and physical hazards within the AIV's value chain in Kenya have a direct effect on consumer's health. There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in AIV's value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the AIV's supply from biological, chemical and physical hazards into the hands of food management systems. The system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls.
Justification	There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of Escherichia coli (E. coli), Salmonella spp., Aspergillus flavus and Aspergillus parasiticus. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects. There is need to put in place risk analysis and hazard monitoring and management system to ensure that food contaminants are kept at bay along the AIV's value chain. Presence of these contaminants not only poses serious risks to human health and trade. Such tools are used globally and even adapted by Codex Alimentarius as a global acceptable FSMS. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range as required. Parameters will be quantified for production, harvesting, processing, distribution and value addition
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	AIV's value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• Training of stakeholders on GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP) • AIV's innovation platforms • FFBS sessions • Through common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).
Critical/essential factors for successful promotion	• Formation of "experts" team composed of HACCP specialists, food scientists, microbiologists, representative of the AIV's (and other similar crops) value chain players, public health officers, and a quality control and safety specialists from the competent authorities to guide the process • Local and National governments support
Partners/stakeholders for scaling up and their respective roles.	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players • Farmers/farmer groups • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • National competent authorities • Analytical testing services • Processors and local traders
C: Current situation and future scaling up	
Counties where already promoted if any	• Not promoted in any county of Kenya
Counties where TIMPs will be up scaled	• All counties growing and consuming AIV's in Kenya.
Challenges in development and dissemination	• Inadequate funds to reach value chain actors • New concept not very well known among the primary stakeholders and market outlets
Suggestions for addressing the challenges	• Funding of dissemination platforms • Training of all stakeholders on food safety
Lessons learned in up scaling, if any	• None since scaling up has not been done
Social, environmental, policy and market conditions necessary for development and up-scaling	• AIV's being observed by stakeholders as a food and commercial crop that requires protection from contamination • Use of less toxic crop protection methods in handling crop health issues

	• Establishment of practical and acceptable food handling protocols at both county and National levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth might not be aware of the existing hazards, their preventive measures and control • Women and youth might to be aware of the impact identified hazards could have to their health • In harvesting and processing AIV's to meet the acceptable national standards, women and youth play critical roles. • Therefore, there is need to build the capacity of women and youth in the identifications of food safety hazards/risks and the control measures along AIV's value chain • Women and youth lack finances
Gender related opportunities	Opportunities exist for women and youth in the marketing and use of AIV's and it's by products as an entrepreneurship.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • VMGs have limited participation in decision making at community and County level • Require strategies that target the VMG during scaling up of the AIV's value chain.
VMG related opportunities	• Identification of critical limits to be defined • Control measures to be identified • Criteria for compliance already clearly defined for adoption
○ **E: Case studies/profiles of success stories**	
Success stories	N/A
Application guidelines for users	• HACCP general guidelines - https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/ • General principles of food hygiene - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%25253A%25252F%25252Fworkspace.fao.org
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling;
○ **G: Contacts**	

Contacts	The Institute Director, FCRI Njoro; Email director.fcrinjoro@kalro.org The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seeds, E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	8. 1. Mr. John N. Ndung'u, FCRI - KALRO Njoro 9. Antony Nyaga, KALRO Seeds Thika 10. Dr. Francis Wayua, KALRO Kakamega 11. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 12. Mrs. Violet Kirigua, KALRO Headquarters 13. Beatrice Wanjiku, KALRO Njoro
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, KEBS, County governments, NGO's and Universities.

7.0 Slenderleaf Clotoraria Brevidens Technologies and Innovative Management Practices

7.1 Improved slenderleaf varieties

Katumani Mito 1

TIMPS name	**Katumani Mito 1**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low yields for current local varieties
What is it? (TIMP description)	High yielding - 8 t/ha^{-1} Wide harvesting intervals Attacked by few pests and diseases The vegetable is a rich source Vitamin A and C which improve blood circulation and immunity. It also contains calcium responsible for strong bones. It has zinc which helps to repair worn out tissues. It is a good source of iron, beta carotene, flavonoids It has a mild taste
Justification	The Katumani Mito1variety yields higher than the local varieties therefore improving the productivity of slender leaf vegetables. The variety does well due to its ability to fix atmospheric nitrogen, it is drought tolerant and suitable for intercropping. Besides it is fast

	growing, establishes very fast and can be grown throughout the year under irrigation**.**
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, farmer groups, traders and seed companies
Approaches used in dissemination	Training materials, farmer field days, shows and exhibitions, demonstrations, farmer trainings
Critical/essential factors for successful promotion	Preferred traits by farmers, consumers and market niches Promotion methods used
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors, sensitize farmers on technology) Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Machakos, Kitui and Makueni
Challenges in development and dissemination	Inadequate funding for technology development and dissemination, Inadequate/lack of information on production knowhow.
Suggestions for addressing the challenges	More funding for research and extension services
Lessons learned in up scaling, if any	- Farm yard manure key in production of Slenderleaf.
Social, environmental, policy and market conditions necessary for development and up-scaling	- Up scaling of developed technologies (Varieties) and agronomic packages. - Put in place an efficient seed system. - More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens).
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Production of Slenderleaf is economically viable although not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to productive resources such as land, farm equipments and credit facilities as compared to men • Women have limited access to education, training and extension services than men hence might not have information on improved slenderleaf Katumani Mito 1 variety • Women have low production of slenderleaf as they plant poor quality seeds as they do not have finances to purchase improved seeds of the new varieties • Women have limited access to markets such as agro-vets

	where they can buy new seeds due to limited mobility associated with their domestic roles
Gender related opportunities	• Improved slenderleaf Katumani Mito 1 variety is a fast growing hence has the potential of providing stable supply of vegetables to the markets hence increased income for women • Improved slenderleaf Katumani Mito 1 variety has the potential of providing food security and nutrition for women and youth • Improved slenderleaf Katumani Mito 1 variety is high yielding hence has the potential of providing employment for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to training and extension services they might not have access to new information relating to improved slenderleaf Katumani Mito 1 variety • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure hence they might not have access to Improved slenderleaf Katumani Mito 1 seeds • The VMGs might not be able to purchase Improved slenderleaf Katumani Mito 1 variety seeds as they do not have finances due to limited access to credit facilities • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• If Improved slenderleaf Katumani Mito 1 variety is adopted there will be high production of slenderleaf leading to employment for VMGs • There will also be increased incomes for VMGs • There will be increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRRO Katumani,

	P. O. Box 340-90100, Kakamega , Kenya
Lead organization and scientists	KALRO; F. Omari, C. Ndinya
Partner organizations	Ampath Moi Referral Hospital, University of Eldoret, Chuka University, World Vegetable Centre

7.2 Katumani Mito 2

TIMPS name	Katumani Mito 2
Category (i.e. technology, innovation or management **practice)**	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of improved varieties, low yields
What is it? (TIMP description)	- The Slenderleaf vegetable is a rich source of Vitamin A and C and proteins. - It also contain minerals like calcium, zinc and iron. - It is a good source of antioxidants. - It has a bitter taste - High yielding - 8 t/ha^{-1} - Wide harvesting intervals - Attacked by few pests and diseases
Justification	Slenderleaf is very nutritious, contains vitamins, minerals and bio-active compounds and blends well with both exotic and indigenous vegetables to improve texture and taste and is therefore in highly demanded. Besides it is fast growing and establishes very fast. Slenderleaf can be grown throughout the year under irrigation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, farmer groups, traders and seed companies
Approaches used in dissemination	Training materials, farmer field days, shows and exhibitions, demonstrations, farmer trainings
Critical/essential factors for successful promotion	A high demand for slenderleaf all over the country, Reliable market outlets as such as supermarkets, hotels and hospitals
Partners/stakeholders for scaling up and their respective roles.	Extension service providers (train farmers, create linkages between actors), Research Organizations (Technology generation, developing extension messages, training ToTs and farmers), Seed companies (Seed production) and traders (sale of inputs) and producers (farming)
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Bungoma, Busia, Vihiga, Kisii, Homa Bay, Migori, Kisumu, Vihiga, Siaya, Trans Nzoia, Uasin Gishu and Nandi
Counties where TIMPs will be up scaled	Kakamega

Challenges in development and dissemination	Inadequate funding for technology development and dissemination, Inadequate/lack of information on production knowhow.
Suggestions for addressing the challenges	More funding for research and extension services
Lessons learned in up scaling, if any	- Farm yard manure key in production of Slenderleaf. - Consumer taste of Slenderleaf to exotic
Social, environmental, policy and market conditions necessary for development and up-scaling	- Up scaling of developed technologies (Varieties) and agronomic packages. - Put in place an efficient seed system. - More sensitization on commercial benefits of AIVs (still considered a subsistence crop hence still grown in kitchen gardens.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Production of Slenderleaf is economically viable although not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to productive resources such as land, farm equipments and credit facilities as compared to men • Women have limited access to education, training and extension services than men hence might not have information on improved slenderleaf Katumani Mito 2 variety • Women have low production of slenderleaf as they plant poor quality seeds as they do not have finances to purchase improved seeds of the new varieties • Women have limited access to markets such as agro-vets where they can buy new seeds due to limited mobility associated with their domestic roles
Gender related opportunities	• Improved slenderleaf Katumani Mito 2 variety is a fast growing hence has the potential of providing stable supply of vegetables to the markets hence increased income for women • Improved slenderleaf Katumani Mito 2 variety has the potential of providing food security and nutrition for women and youth • Improved slenderleaf Katumani Mito 2 variety is high yielding hence has the potential of providing employment for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to training and extension services they might not have access to new information relating to improved slenderleaf Katumani Mito 2 variety • VMGs have limited access to markets as they sometimes

	cannot travel to far regional markets due to either their sickness, disability or lack of exposure hence they might not have access to Improved slenderleaf Katumani Mito 2 seeds • The VMGs might not be able to purchase Improved slenderleaf Katumani Mito 2 variety seeds as they do not have finances due to limited access to credit facilities • VMGs have limited access to seed and information on new varieties and production techniques due to illiteracy
VMG related opportunities	• If Improved slenderleaf Katumani Mito 2 variety is adopted there will be high production of slenderleaf leading to employment for VMGs • There will also be increased incomes for VMGs • There will be increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	1. Traditional African vegetables in Kenya, Production, marketing and Utilization by P. Nekesa and B Meso *Proceedings of the IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa: Conservation and Use 29-31 August 1995, ICRAF-HQ, Nairobi, Kenya* 2. African Indigenous vegetables in Urban Adgriculture By MW Pasquini
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Katumani, P. O. Box 340-90100, Machakos , Kenya
Lead organization and scientists	KALRO; C. Ndinya, M.Odendo
Partner organizations	KEPHIS, Extension Providers, CBOs

GAPs
Required:
Identification of superior slenderleaf varieties

7.2 AIVs Seed systems: Crotolaria

TIMP Name	Formal Crotolaria seed system

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Crotolaria is mainly due to low availability of diverse high-quality and locally adapted Crotolaria seed varieties. About 80% of Crotolaria seed is from informal seed system with no quality assurance.
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The formal Crotolaria seed system is characterized by a well-regulated and organized set of activities, from breeding to delivering certified seeds of known and registered varieties to farmers and other stakeholders. It ensures continuous production, processing, supply and distribution of quality Crotolaria seeds to farmers through organized marketing channels.
Justification	The formal seed system comprises registered seed producers or seed companies and the certification process, which is usually controlled by a public regulatory body (KEPHIS), thus assuring high seed quality for improved yield. Supply of good quality seeds strengthens the trust of farmers in seed producers and sellers and encourages variety adoption.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, traders • Research organizations and universities, Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs) •
Approaches used in dissemination	• Training • Field days, exhibitions, seed fairs, demonstrations, agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche • Application of Participatory methods to promote the seed model and varieties • Offering seed at affordable prices • Organized Crotolaria product market • Strong Partnership of actors

Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed, seed multiplication and technical backstopping • JKUAT: Breeders' seed, seed multiplication and technical backstopping • Seed companies: Seed multiplication, distribution and technical backstopping. • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs):: Seed multiplication and dissemination • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume Crotolaria products to create demand for Crotolaria seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed • World Vegetable Centre: Funding and technical backstopping
• **C: Current situation and future scaling up**	
Counties where already promoted. if any	• Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	• Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released. • Low availability of basic seed for multiplication of certified seed • Low demand for Crotolaria seeds: Most farmers recycle their own seed and cost of seed is high. • Poor quality/fake seed of Crotolaria from seed companies/agro dealers. • Most farmers not aware of potential of seed from formal seed systems.
Suggestions for addressing the challenges	• Lobbying for funding of Crotolaria research and multiplication of basic seed. • Multiplication of seed with farmer preferred traits and offered at affordable prices • KEPHIS to improve seed inspection in agro-dealer networks to ensure quality of Crotolaria seed and reduce sale of fake seed • Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.

Lessons learned in up scaling, if any	• Adoption of Crotolaria seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt. • Favourable agro-ecological conditions. • Availability of adequate market for Crotolaria seed and products. • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Crotolaria production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Crotolaria is considered women's crop. and requires low external resources for production. Most labour for Crotolaria production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Crotolaria as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Crotolaria productivity for food and nutrition security and income generation. In particular, production of Crotolaria is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products

	suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Crotolaria. Youth could also benefit through application of ICT networking for marketing of Crotolaria. • Demand for labour for the seed system offers an opportunity for income generation for both men and women • Women can enter Crotolarias commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Crotolaria. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. • Under the two projects, farmers in Nandi and Kakamega counties produced seed of AIVs species (Crotolaria, Crotolaria, nightshade, cowpea, slender leaf, jute mallow) using both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels • National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems under KALRO SEED. Farmer groups in Vihiga county

	formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and sell in Nairobi
Application guidelines for users	• Leaflets on Crotolaria seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)—	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

5. Narrow range of varieties with market preferred traits
6. Low demand for AIVs seed from formal seed system

TIMP Name	Informal Crotolaria seed system
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Crotolaria is mainly due to low availability of diverse high-quality and locally adapted Crotolaria seed varieties. About 80% of Crotolaria farmers grow seed from informal seed system with no quality assurance. Farmers have limited access to seed from formal seed sector due to high cost of the seed and limited varieties with desired traits
What is it? (TIMP description)	A seed system is a set of activities contributing to variety development and seed production and delivery to farmers. The informal Crotolaria seed system entails seed selection, treatment, storage, multiplication, and distribution. The informal Crotolaria seed system is outside the control of government agencies, with no external seed quality control. This system includes farmer-saved seed, gifts, barter, exchange and seed purchasing from local markets.
Justification	Available Crotolaria seeds are predominantly Open-Pollinated Varieties (OPVs). The private sector has low incentive to produce the OPVs because farmers can recycle the varieties for several seasons without marked yield loss. The informal seed sector is justified for accessing Crotolaria seed due to low availability of improved varieties with desired traits and high cost of seed from formal sector.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups, • Seed companies • Agro-dealers, Traders, • Research organizations and universities, • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs)
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs Demonstrations, Agricultural shows • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market niche. • Application of Participatory methods to promote the seed model and varieties

	• Offering of seed at affordable prices • Organized Crotolaria product market • Strong partnership of actors
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups • Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume Crotolaria products to create demand for Crotolaria seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released • Low availability of basic seed for multiplication of certified seed • Quality of seed not assured • Low demand for Crotolaria seeds: Most farmers recycle their own seed and cost of seed is high.
Suggestions for addressing the challenges	• Lobbing for funding of Crotolaria research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices • Capacity building of farmers and farmer groups on high quality Crotolaria seed production • Sensitize farmers and other stakeholders on benefits of AIVs seed from formal seed system.
Lessons learned in up scaling, if any	• Adoption of Crotolaria seeds from formal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption • Strong partnership linkages are important in seed technology dissemination and adoption • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling

Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt • Favourable agro-ecological conditions • Availability of adequate market for Crotolaria seed and products • Favorable policies and regulations to support informal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Crotolaria production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Crotolaria is considered women's crop. and requires low external resources for production. Most labour for Crotolaria production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Crotolaria as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Crotolaria productivity for food and nutrition security and income generation. In particular, production of Crotolaria is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Crotolaria. Youth could also benefit through application of ICT networking for marketing of Crotolaria. • Demand for labour for the seed system offers an opportunity for income generation for both men and women

	• Women can enter Crotolarias commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Crotolaria. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• No known case of successful informal Crotolaria seed system •
Application guidelines for users	• Leaflets on Crotolaria seed varieties available at KALRO-Kakamega.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani
Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

Research Gaps

TIMP Name	**Semi-Informal Crotolaria seed production system**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield of Crotolaria is mainly due to low availability and limited access to diverse "high-quality locally adapted AIVs seed varieties to farmers and other stakeholders. In addition, farmers have limited knowledge and skills in seed selection,

	treatment, storage, multiplication, and distribution. Farmers' demand for seed from formal sectors is low due to several reasons including low availability, high cost and lack varieties with desired traits.
What is it? (TIMP description)	The semi-formal seed system (termed community-based) is at the interface of formal and informal seed systems. A community-based seed production system involves individual farmers or farmer groups or cooperatives producing quality seed of farmers and improved varieties (at testing and sensitization stage) using the formal seed production guidelines.
Justification	High quality seed is produced by a seed producer subject to quality control and complying with the minimum standards for the crop species concerned. The requirements for Semi-informal seed are less stringent than those of certified seeds while guaranteeing satisfactory seed quality. The cost of such seed is more farmer-friendly and varieties are produced according to farmer demands.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Farmer groups • Seed companies • Agro-dealers, traders, • Research organizations and universities • Public Extension (Ministry of Agriculture and Livestock, Development) • Private extension (CBOs, NGOs) •
Approaches used in dissemination	• Training • Field days, Exhibitions, Seed fairs, Demonstrations, Agricultural shows , • Agricultural Innovation platforms, • Digital platforms • Mass media
Critical/essential factors for successful promotion	• Multiplication of varieties with traits preferred by farmers, consumers and market nicheApplication of Participatory methods to promote the seed model and varieties • Offering of seed at affordable prices • Organized Crotolaria product market • Strong Partnership of actor
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Breeders' seed and technical backstopping • JKUAT: Breeders' seed and technical backstopping • Public Extension: Mobilizing and training farmers and farmer groups

	• Private extension (CBOs, NGOs): Seed multiplication and dissemination • • Farmers: Test/validate seed varieties and produce the seed • Individual consumers: consume Crotolaria products to create demand for Crotolaria seed (derived demand) • Institutions (hospitals, schools, colleges): provide derived demand for seed
C: Current situation and future scaling up	
Counties where already promoted. if any	Kakamega, Nyamira, Kisii, Vihiga
Counties where TIMPs will be up scaled	Busia, Bungoma, Nandi, Siaya, Kisumu, Uasin Gishu, Trans Nzoia, and other counties in Kenya where sufficient water is available and demand for the vegetable exist.
Challenges in development and dissemination	• Breeding of new varieties is still in its early stages and a few varieties released • Low availability of basic seed for multiplication of certified seed • Low demand for Crotolaria seeds: Most farmers recycle their own seed and cost of seed is high. • Most farmers aware of potential of seed from semi-formal seed systems
Suggestions for addressing the challenges	• Lobbying for funding of Crotolaria research and multiplication of basic seed • Multiplication of seed with farmer preferred traits and offered at affordable prices. • Sensitize farmers and other stakeholders on benefits of AIVs seed from semi-formal seed system.
Lessons learned in up scaling, if any	• Adoption of Crotolaria seeds from informal seed systems can be enhanced when seeds with farmers' preferred traits are promoted and disseminated. • Participation of end-user in technology development process helps incorporation of users' preferences and hastens adoption. • Participation of champions enhances adoption of seed • Strong partnership linkages are important in seed technology dissemination and adoption. • Building capacity of stakeholder on products/seed varieties and dissemination approaches are key to upscaling.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Varietal traits fit into community culture, farmers' preferences, and practices, hence farmers' willingness to adopt

	• Favourable agro-ecological conditions • Availability of adequate market for Crotolaria seed and products • Favourable policies and regulations to support formal seed sector.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Base yield: 20 MT/acre; Improved variety: 30 MT/acre (400 PCS @130)=52,000
Estimated returns	Additional revenue/acre (10*130) =KES 13,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women play a key role in Crotolaria production. However, they have limited access to productive resources such as land, irrigation equipment and quality seeds than men. • Crotolaria is considered women's crop. and requires low external resources for production. Most labour for Crotolaria production is provided by women; therefore, increased production is likely to provide employment to women. • With commercialization of Crotolaria as a woman's crop, most of the cash from the sales is likely to be retained by women and used to improve the household livelihoods of all members • Adoption of high quality seed aims at increasing Crotolaria productivity for food and nutrition security and income generation. In particular, production of Crotolaria is likely to increase its consumption especially by women and children to alleviate vitamin and micronutrients deficiencies. • Gender inclusiveness in research and development of formal seed system will assist is generation of products suitable for both men and women, thus hastening the adoption. • Women may have limited access to markets as they are involved in several domestic chores, thus depriving them time to travel to the market
Gender related opportunities	• Affirmative action targeting women and youth for dissemination, adoption and consumption of the Crotolaria. Youth could also benefit through application of ICT networking for marketing of Crotolaria. • Demand for labour for the seed system offers an opportunity for income generation for both men and women

	• Women can enter Crotolarias commercialization using locally available resources such as organic manures • Digital marketing can facilitate women, men and youth access to markets
VMG issues and concerns in development, dissemination, adoption and scaling up	• Prejudice associated with social-economic status of VMGs lead to their exclusion from access to productive resources such as land, information and quality seeds and benefits arising from application of high value seed. • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure •
VMG related opportunities	• Affirmative action targeting the VMGs for dissemination, adoption and consumption of the Crotolaria. • The VMGs can be involved in production of the he crop using locally available resources such as organic manures leading to economic empowerment. • Digital marketing can facilitate VMGs access to markets rather than travel to physical markets.
E: Case studies/profiles of success stories	
Success stories	• Horticulture Innovation Lab (HORTINNOVATION)-USAID (2015-2019); and HORT CRSP (2010-2014)-Rutgers University: projects at KALRO Kakamega. Under the two projects farmers in Nandi and Kakamega counties produced seed of AIVs species (Crotolaria, Crotolaria, nightshade, cowpea, slender leaf, jute mallow) in both formal and semi-informal seed systems. KALRO Kakamega trained farmers on seed systems and KEPHIS inspected the seed. The farmers are growing AIVs and supplying to hotels • National Research Fund (NRF): (2018-todate): AIVs seed production through formal and semi-informal seed systems. Farmer groups in Vihiga county formed a collection center for ease of marketing AIVs. They have a solar drier they dry vegetables and send to Nairobi
Application guidelines for users	• Leaflets on Crotolaria seed varieties available at KALRO-Kakamega
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	KALRO Kakamega, KALRO Katumani

Lead organization and scientists	KALRO Christine Ndinya
Partner organizations	KEPHIS, KALRO, MoA, CBOs

7.3 Agronomic management practices slenderleaf

TIMPS name	**Variety selection, Seed acquisition or Own Seed Selection, Planting, Weeding, Thinning, Fertilizer Application, Pest and Disease Management, Harvesting, Storage and.**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Low farm yields • Poor management and agronomic practices at farm level • Mitigation of pest and diseases
What is it? (TIMP description)	This includes :- **seed acquisition:** - Certified seed or training on proper own selection **Rainfall** Requires well distributed rainfall with annual average of 500mm-2700mm. **Temprature** Thrives well at 12-30^{0}c. **Land preparation** - Ploughing and Harrowing operations are necessary - Slenderleaf is a very small seeded hence fine seedbed (tilth) is required **Planting and seed rate** - Early planting - Depth 5 cm. - Seed rate 2-3 Kg/acre - Mix seeds with dry sand or soil at the rate of 1 part Seed to 3 parts dry soil/sand
	Spacing - Make shallow drills spaced 45 - 60cm apart - Slenderleaf (*Crotalaria brevidens*) can be broadcast or drilled in rows 30 cm apart. The seedlings are thinned to a spacing of 15-20 cm x 15-20 cm after 6 weeks. It can be intercropped with other crops such as finger, maize sorghum millet. **Weeding:** - Keep the crop weed free until it is well established - There after weed as necessary

	Thinning: - Subsequent thinning should be done after the fourth week of planting. **Harvesting:** - Thinned plants are used as the first harvest. - Harvesting begins at week 8 and continues up to four months.
Gender issues and concerns in development, dissemination , Gender adoption and scaling up	Slender leaf plant stakeholder might not have adequate knowledge of the existing good agronomic practice especially women since they have less access to agricultural information and extension services Women and youth have the perception that good agronomic practices are oppressive, time consuming and labour intensive as they do not see the working for their good Most small-scale production systems are centered women and hence it's them who suffer from the detriments of poor processes; for example, improper site selection , preparation sowing, thinning and harvesting Women farmers have no finances to pay hired labour so as to ensure that good agronomic practices are embraced due to limited access to credit facilities Women are the ones who are usually engaged in spider plant production and they are usually left out when important agricultural workshops are held due to the social status in the community
Gender related opportunities	Increased productivity will benefit the household Adopting agronomic practices will lead to increased production of the spider plant hence there will be creation of employment for women and youth Adopting appropriate agronomic practices will lead to improved food security and nutrition for house holds Adopting appropriate agronomic practices will lead to increased income for women and youth
VMG issues and concerns in development, Dissemination, adoption and scaling up	• Some of the agronomic practices are complicated for VMGs to undertake such as land preparation especially for those who are abled differently • VMGs have no finances due to limited credits to hire labour and also to purchase required facilities required while applying appropriate agronomic practices • VMGs might not be able to get information relating to appropriate agronomic practices due to limited access to agricultural information and extension services • Due to their social status VMGs are often excluded from participating in workshops and in dissemination meetings

	relating to where appropriate agronomic practices are discussed • Most of the VMGs might not get adequate information relating to the agronomic practices due to unfriendly dissemination methods and low illiteracy of the VMGS
VMG related opportunities	. • Increased income due to improved production as a result of using appropriate agronomic practices by VMGs • There is potential of stable income and livelihoods for the VMGs • Application of appropriate agronomic practices will lead to improved food security and nutrition for VMGs

7.4 Soil Fertility Management TIMPs for Slender Leaf

Rapid Soil Testing Services

1.4. TIMP name	**Rapid Soil Testing Services**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are expensive for farmers, results take long and are not reproducible. Further, conventional methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing using the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It does not require the routine laboratory analysis using chemicals. When a sample is run though a scanner, soil testing results are generated with accompanying recommendations instantly. However, the method requires partners involved (ICRAF, iSDA and SoilCares) to work closely with KALRO and county agricultural officers to sensitize farmers to embrace the testing method.

	This innovation will involve working closely with agronomists to generate specific fertilizer recommendation driven by soil and crop data obtained.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches used in dissemination	Farmer visits Training in workshops Publicity campaigns done at County levels
Critical/essential factors for successful promotion	• Availability of the necessary equipment (Scanner and accessories) for rapid on-site soil testing. • Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. • A well-designed information storage system for data obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data, fertilizer recommendation according to crop type suitability). • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	• County government extension services; Providing the link to farmers. • Soilcares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and iSDA; Tests and validate the recommendations obtained in collaboration with SoilCares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	

Counties where already promoted if any	Technology has not been promoted though testing has been ongoing in a few counties
Current Counties where already promoted if any	Minimal reach in Nyeri County
Counties where TIMP will be promoted	All 24 KSAP Counties
Challenges in dissemination	• It requires continuous updating of methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated methods for updating existing recommendations by generating local soil libraries.
Lessons learned if any	Timely affordable soil information will guide on fertilizer use. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Copper.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly; -Recommendations provided ensures that farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Market will absorb the increased productivity • Supporting frameworks/policies are available. • Training of personnel at national and County levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Soil testing equipment and License, sampling and packaging materials (Kes 650,000/=), personnel and logistics (will depend on site/location). • Shipping selected soil and plant materials for further testing and results verification in a certified lab. • There are other additional costs on professional consultation.
Estimated returns	At least 30% profit for soil testing business venture using the scanner. Farmers end up getting higher returns on the crops grown and amounts depend on specific value chain. High value crops will give higher returns compared with subsistence crops.

Gender issues and concerns in development, dissemination, adoption and scaling up	• By bringing services closer to the users saves farmers (men, women and youth) time and resources.
Gender related opportunities	• Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. • The scanner equipment is light and women and youth can easily transport and operate it.
VMG issues and concerns in development, dissemination, adoption and scaling up	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and is also expected to improve productivity
E: Case studies/profiles of success stories	
Success stories	Has been tested used successfully by other organizations like ICRAF, SoilCares & former Kenya Sugar Research Foundation. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugar cane
Application guidelines for users	• A handheld scanner to test soils and crops in the field • Community soil sampling champions are identified and trained on good soil sampling procedures. • Soil and crop is analysed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO; C. Kibunja, E. Gikonyo, Christy van Beek, A. Sila, D. Kamau, A. Esilaba and S. Kimani
Partner organizations	County governments in the 24 counties, SoilCares, ICRAF and iSDA

Research gaps

1. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
2. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller

quantities as per farmer needs.

5. Using scanners at farm level to undertake fertilizer quality analysis, e.g. quantitative and qualitative analysis, major and trace elemental analysis, and chemical and physical analysis.
6. Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country

Integrated Soil Fertility Management (ISFM)

1.1. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil fertility, low organic matter, poor soil structure and limited available moisture in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed and good agronomic practices to adapt to local conditions. ISFM places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence
Justification	Soils within the farming system are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. The aim of ISFM is therefore to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Training in workshops On-farm visits Farmer field schools (FFS) On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; • Availability of clean/certified seed • Availability of novel crop protection practices, and • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in
Partners/stakeholders for scaling up and their roles	• County government extension services - Provide linkage with farmers. • Community farmer groups - play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Current Counties where already promoted if any	Practised in some value chains in the 10 Counties above
Counties where TIMP will be promoted	Bomet, Kericho, West Pokot, Taita Taveta, Lamu, Nyandarua, Tana River, Baringo, Marsabit, Garissa, Kajiado, Laikipia
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Lack of guidelines on how to combine manures/organic materials with modest amounts of mineral fertilizers. • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, etc is required since farmers tend to re-use previous planted materials.

	Knowledge of how to combine organic and inorganic fertilizers is required.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Increased productivity will provide supply to the markets, • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically demanding technology and high cost are incurred in acquisition of inputs.
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice integrates participation of male and female gender roles during field activities. Female gender is disadvantaged where application of heavy loads of manure is to be incorporated in the field. Adoption and scaling up of ISFM technologies could be affected by: Ownership of the farm, that are mainly male owned but the implementer of the ISFM in most cases is female Quality inputs and their availability in time
Gender related opportunities	Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that save on cost which benefits all gender in the farm household.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs are physically disadvantaged for a practice that seeks to incorporate manures, and chemical sprays in the farm. They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice
VMG related opportunities	The technology if well practised can increase farm incomes of VMGs by up to 50%.
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in maize in central and western Kenya highlands. Successes have also been reported for sorghum and millet value chains in Machakos where the productivities have been improved
Application guidelines for users	• Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. • Ensure that good agronomic practices are upheld • For sustainability, use of pure inorganic or organic materials should be avoided but should be used in recommended combinations.

	• Adapt the practice to local conditions
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete R. O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; E. Gikonyo, C. Kibunja, A. Muriuki, D. Kamau, A. Esilaba, J. Ndufa and S. Kimani
Partner organizations	County governments, NGOs, CIGs, KEFRI

Research Gaps

1. Validation of the ISFM technology in Counties where technology has not been tested.
2. Testing (fertilizer types, rates, frequencies) and combination with manures for different value chains

Integrated Manure Management (IMM)

1.2. TIMP name	**Integrated Manure Management (IMM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)  *Source: J. Oyoo, Tigoni*	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops. Manure is obtained from different animals (poultry, cow, goat, horse) on the farm, but it can also be bought from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties all of which are important for soil quality and crop production.

Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are depleted at annual rate of 22kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health. The efficient use of manure is enhancing the capacity of the soil to conserve and accumulate soil organic carbon; maintain or improve crop yield by supplying nutrients when required by plants and reduce effects of climate change through sequestration of carbon.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Public and private practitioners
Approaches used in dissemination	On-farm and on-station demonstrations Open and Field days Agricultural shows MoA/Extension officers Partners Farmer to farmer peer learning Mass media- e.g Mkulima programme, Smart Farmer and Seeds of Gold Workshops, Seminars, Meetings, trainings Promotional materials (posters/brochures/leaflets) Social Media platforms Exchange visits
Critical/essential factors for successful promotion	• Training on feeding, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using several crops
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I)-National and County level - extension services and link with farmers CIGs (Common Interest Groups)- co-ordination roles and back stopping at grass root levels ILRI- technical backstopping

	NGOs (Non-governmental organizations)-promotion, micro financing etc.
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Uasin Gishu
Current Counties where already promoted if any	Though small scale farmers in the counties apply manures and composts on their farms, they do not optimize on usage.
Counties where TIMP will be promoted	Bomet, Kericho, Laikipia, West Pokot, Taita Taveta, Nyandarua, Lamu, Tana river, Baringo, Marsabit, Garissa, Siaya, Kisumu
Challenges in dissemination	• Limited model demonstration farms • Cultural challenges -Lack of interest by pastoral communities • Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	• Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure preparation, storage and application
Social, environmental, policy and market conditions necessary	• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbour pathogens which can cause disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and

	finally transporting and applying it field which take a lot of effort and time. Manure costs are dependent on types e.g. goat, sheep, poultry Using locally available manure/composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practised
Gender issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application (often by broadcasting) hence may disadvantage women and youth
Gender related opportunities	Manure is locally available for farm households who keep livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application hence may disadvantage VMGs. The VMGs are also resource poor, hence may not have access adequate manures, e.g. need large livestock herds
VMG related opportunities	Manure is locally available for those farm households with livestock and can build on what they already own
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income e.g. keeping one steer in a smallholder farm measuring 0.45ha in central Kenya produces manure equivalent to 112kgN/ha/year of whole farm area when optimum collection and manure composting strategies are followed.
Application guidelines for users	The guideline focus on the following areas:- • Animal feeds • Livestock housing and manure collection • Manure storage to preserve nutrient and avoid loses • Manure treatment for ease of transport and application in the field • Timing of application for maximum utilization by the crop • Anaerobic digestion for biogas production • Regular analysis of manure to ascertain the quality • Manure/Composts take a long time to cure, hence need good planning prior to use • IMM is always site specific and users advised to only use information relevant to local circumstances
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation

G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations	County government, Private Public Partnerships, CIGs

Research gaps

1. Promote IMM complementary technology in counties that have not practised it.
2. Conduct nutrient budget study on selected farms utilizing manures (including composts) in each of the 24 Counties.

7.5 Soil and Water Management TIMPs for Slender Leaf

Rain water harvesting through Roof water catchment

2.6. TIMP name	Rain water Roof water catchment
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)  *Source: C. Kundu,*	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface run off). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. Examples of rainwater harvesting are rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage By collecting, storing and utilizing water agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting

	high- value crops, and extending their growing season through the entire year. Technology also slows water run off and increases yields with the additional water
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralists
Approaches used in dissemination	Demonstrations on technology use; Farmer Field Schools; Technical training and re-tooling of extension personnel; Awareness creation through various platforms like local FM stations
Critical/essential factors for successful promotion	• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems • Policy to support use of communal land to establish and manage the earth dams • Policies supporting Public-Private Partnerships in water harvesting • Sensitization of local communities to embrace the practice
Partners/stakeholders for scaling up and their roles	• Private sector – access to technology, access to credit, technology installation • County government – capacity building, policy support, credit facilities, • NGOs – access to technologies, capacity building, technology installation
C: Current situation and future scaling up	
Counties where already promoted if any	Most counties are investing on water harvesting technology at community level. More is required to increase uptake at household level
Current Counties where already promoted if any	Practised widely in most counties
Counties where TIMP will be promoted	ASAL counties; Tana River, Marsabit, West pokot and Mandera
Challenges in dissemination	• High costs related to technology access and management • Resource use conflicts where land is communally owned • Limited skills in technology installation and management • Limited community mobilisation policy for water related activities • Lack of suitable training programmes in rainwater harvesting • Lack of proper water usage and control measures • In the case of earth dams where there is a lot of siltation, regular de-siltation is required.

	• Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance. • Vandalism • Some systems require high investment costs
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training programs water harvesting technologies, maintenance and operation skills • Cost of buying water harvesting structures is very high for most households and needs to be reviewed. • Securing systems to prevent vandalism
Lessons learned if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented
Social, environmental, policy and market conditions necessary	• Devise systems that are gender sensitive – target different gender needs • Carry out environment and social impact assessment of the technology in specific Counties and cultures • Support structures that help access to credit for technology access and maintenance • Enact Policy frameworks to support water harvesting • Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost dependent on the type of materials to use for harvesting and storage. Not readily affordable to most rural households
Estimated returns	• Time saved fetching water from afar is channelled into other economic enhancing activities. • Money used to treat diseases related to poor water hygiene is used for other activities. • Healthy population will have energy to provide labour required in agricultural activities
Gender issues and concerns in development, dissemination, adoption and scaling up	• The distance from household need to be considered as women are the custodian of households in terms of domestic water demands. • The design of the water pans should take care of the Occupation, Health and Safety of the communities

	• The technologies will reduce time needed to fetch for water which will impact positively the women
Gender related opportunities	Water harvesting facilities save the time spent to collect water from far off, usually by women. The saved time is channelled into other economic activities
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to credit or financial services may limit access to technology • The land tenure systems may inhibit adoption of technology
VMG related opportunities	• Develop SME opportunities around water harvesting. Also do small food gardens and tree nurseries around water pans • VMG maximize can engage in n availability of water to engage in small IGAs around water harvesting • Livestock too easily access water and their market value likely to appreciate • The technology will reduce the time used to search for water
E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres. This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	Agro-pastoralists and farmers in target counties need training and empowerment on the technology and attendant management practices. **References** Handbook on Rainwater Harvesting and Storage Options Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen

F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling
G: Contacts	
Contacts	Director, Environment & Natural Resource Systems KALRO Secretariat P.O. Box 57811-00200 +254 722 206986/8, Ext 2316
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPPs

Research gaps

3. Development of models of rain water harvesting for intensive agricultural production and household use

Mulching

2.3. TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in the soil, weed infestation, loss of organic matter, managing salinity in ASALS and low crop yields.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials such as straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production. Plastics like polythene, and row covers are also used as mulch. Benefits: retain moisture in the soil; suppress weeds; lowers soil temperature; and help improve soil fertility (as the mulches decompose).
Justification	Mulching facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It minimizes weed problems and nutrient loss. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	• Farmer field schools • On-farm demonstrations during farmer field schools • Training in workshops

Critical/essential factors for successful promotion	• Availability of plant or crop residues. • Size of the land. • Competing uses of crop residues. • Type of the crops
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers • Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Current Counties where already promoted if any	Available and practised in different commodity value chains
Counties where TIMP will be promoted	All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses • Possibilities of insect build up categorized as pest or disease vectors
Suggestions for addressing the challenges	• Crop diversification to increase availability of residues. • Establish and follow a good integrated pest control management program for the particular crop. • Adapting alternative mulching materials like high absorbance polymers in fruit trees like mangoes and Bananas, as well as plastic mulches and row covers in vegetables
Lessons learned if any	There is need to adapt alternative mulching technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive practice during the initial application. Such costs are dependent on value chain and plant spacing. However, plastic mulch is costly and needs to be used for high value crops.
Estimated returns	Dependent on the type of value chain and mulch used

Gender issues and concerns in development, dissemination, adoption and scaling up	The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict for those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere. Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is be a bit labour intensive for VMGs, hence its adoption and scaling up
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	Judith Henze, Mary Abukutsa-Onyango, and Arnold Opiyo, 2020. Production and Marketing of African Indigenous Leafy Vegetables. Training Manual for Extension Offcers and Practitioners
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling (Organic mulch) 2 and 3= Requires validation and further research(plastic mulch)
G: Contacts	
Contacts	Centre Director KALRO Kabete. P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, D. Kamau and S. Kimani
Partner organizations	County governments Public-Private-Partnerships

Research gaps

1. Research on mulching using plastics, factory/industrial wastes, e.g. mushroom, tea, coffee, etc. in different value chains is required

7.6 Irrigation and Drainage Management Slender Leaf

Solar irrigation systems for smallholder farmers

3.1. TIMP name	**Solar Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High cost of pumping water for irrigation, using electricity or fossil fuel powered pumps; reduction of greenhouse gas emissions
What is it? (TIMP description)	This is a technology that uses solar power in the pumping of irrigation water and running of the irrigation systems
Justification	There has been general increase in prices of diesel and electricity making pumping of irrigation water to be a costly operation. Though Solar panels have been used successfully to light houses and in small businesses in the rural areas, they have hardly been used in the irrigation systems despite their potential. Solar power would be a good source of power for addressing climate smart agriculture focusing on renewable and green energy. It also has the advantage of low cost and sustainability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	On-farm and on-station demonstrations Field days Training in workshops Stakeholders forums Technical releases
Critical/essential factors for successful promotion	• Documentation of available solar irrigation systems • Access to solar irrigation performance data. • Improving solar irrigation systems efficiencies in irrigation schemes • Creating local support for solar irrigation technologies
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Various Counties including Marsabit, Garissa, Machakos, Nyeri, Kajiado, Siaya, Bomet, Kericho and Uasin Gishu

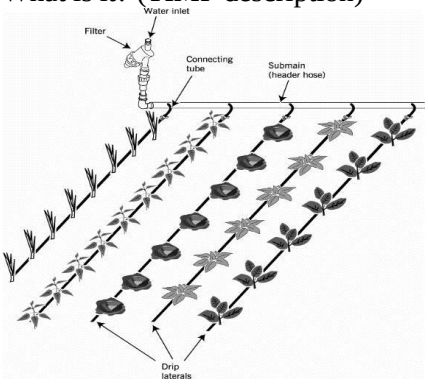
Current Counties where already promoted if any	Practised in individual farms as well as in few group farms for high value crops like tomatoes
Counties where TIMP will be promoted	All the 24 KCSAP Counties
Challenges in dissemination	• Farmers lack knowledge on the potential of solar as a power source for irrigation systems • High cost innovation
Suggestions for addressing the challenges	• Awareness trainings on different solar irrigation systems • Awareness creation on advantages of solar irrigation systems pumps to governments, farmers and development agencies. • Capacity building of extension workers • Developing information packages • Creating solar irrigation systems network
Lessons learned if any	• Solar irrigation systems should be well designed in water delivery, storage and application to the field.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Policies are friendly to the technology • Capable of increasing marketable products
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Higher investment costs but low operation costs. Costs depend on the energy required and size of irrigated area.
Estimated returns	• Not yet done
Gender issues and concerns in development, dissemination, adoption and scaling up	Solar irrigation is friendly to female gender compared to diesel or electric systems because they have low running and maintenance costs. It is modern technology that is attractive to the youth
Gender related opportunities	The systems are adaptable to different irrigation scenarios thus fitting to all genders.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs may not afford the investment costs but will afford the operational and maintenance costs if assisted
VMG related opportunities	The technology can increase farm incomes of VMGs by more than 70% because of the very operation and low maintenance costs
E: Case studies/profiles of success stories	
Success stories	Solar irrigation systems success stories have been reported in Counties such as Kajiado on high value crops
Application guidelines for users	Choose a solar irrigation system that suits the farm area to irrigate Use efficient water application method such as drip to avoid wastage since the water is relatively scarce.

F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; I. V. Sijali, M. P. O. Radiro, F. Karanja, F. Kaburu
Partner organizations	Solar irrigation systems suppliers County governments National Irrigation Acceleration Programme (NIAP)

Research Gaps

1. Validation of the solar irrigation systems in the different counties.
2. Up scaling of the technology to smallholder community schemes
3. Solar irrigation systems that maximize crop water productivity

Drip Irrigation Systems

3.2. TIMP name	**Drip Irrigation Systems for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Increased crop water stress caused by seasonal rainfall variability in rain fed production
What is it? (TIMP description)  Layout of a drip irrigation system in vegetables	This is a technology that supplies water to plants grown in solid substrates in small controlled drops. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water
Justification	The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Main streaming drip irrigation systems into crop production provides the opportunity for farmers to enhance crop resilience, increase yields and incomes.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Model Farmers
Approaches used in dissemination	Field Demonstrations, farmer field schools, ASK trade and exhibition fairs
Critical/essential factors for successful promotion	• Correct field design (system installation) of the drip system to minimize water inefficiencies. Training of farmers and extension • Drip management skills
Partners/stakeholders for scaling up and their roles	• County governments; capacity building, supportive policies and frameworks • Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Bomet, Kajiado, Machakos
Current Counties where already promoted if any	Limited to high value tomato and vegetable farmers in the above counties
Counties where TIMP will be promoted	High value crop production (e.g. tomatoes, vegetables, bananas) in Elgeyo Marakwet, Bomet, Kericho, Kajiado, Mandera, Siaya, Tharaka Nithi, Nyandarua, Nyeri, Kisumu, Busia, Taita Taveta, Machakos, Isiolo, Laikipia, Marsabit, Baringo and Garissa counties
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Suggestions for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned if any	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil • It is also important to link farmers to Micro Finance

	Institutions for financial needs
Social, environmental, policy and market conditions necessary	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems • The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES 100,000
Estimated returns	• Income from drip system rises by as much as 35% stemming from the management of crop water stresses. • Increased water saving means more water is available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Drip systems are easily installed and therefore suitable for both male and female gender • Drip system tends to reduce workload for all gender and provides significant positive impact on family food and nutritional intake. • Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours • Acceptable and easy to scale up by both male and female, including youth
Gender related opportunities	Opportunities available for women and men to generate sustainable income
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMG
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables
E: Case studies/profiles of success stories	
Success stories	There are many successful farmer drip irrigation models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability
Application guidelines for users	• Use appropriate emitters during design and installation i.e. sites with elevation difference of over 1.5 meters (5 feet), use pressure compensating emitters and turbulent flow emitters more level areas. Gravity flow systems normally use short-path emitters • Use 1 or 2 emitters per plant depending on the size of the plant. Trees and large shrubs may need more. • In most situations install emitters at least 450mm (18″) apart. 600mm (24″) apart under 80% of the leaf canopy

	of the plant • Always have a backflow preventer to prevent water contamination by soil-borne disease. Use a 20mm (3/4″) valve for most systems • Use 25mm (1 inch) PVC, PEX or polyethylene irrigation pipe for mainlines ("mains") and laterals • The total length of the mainline and the lateral together should not be more than 120 meters (400 feet). • The length of drip tube should not exceed 60 meters from the point the water enters the tube to the end of the tube • Never bury emitters underground unless they are made to be buried • Don't bury drip tube, moles or other rodents will chew it • Always install a flush valve or end cap at the end of each drip tube. Automatic flush valves are also available **References** 5. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi. 6. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/a-i3765e.pdf
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	1 =Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Isaya Sijali,
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

Research gaps

1. The impact of drip irrigation on economics of agriculture in the regions of adoption under study
2. Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption

7 Integrated Management of Crotalaria Diseases

2.6.7.1 TIMP name	Integrated Management of powdery mildew disease in Crotalaria
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 21% due to Crotalaria infection by the disease
What is it? (TIMP description)	Integrated management of powdery mildew consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural management options**: • Plant early using certified seeds. • Practice crop rotation with non-legumes for a period of 2-3 seasons. • Uproot and destroy severely affected plants, including weeds and volunteer crops by burying them deeply. • Do not walk through your field during wet weather to prevent the spread of the disease from one plant to another. • Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected plants by deeply burying them. **Chemical management options:** • Spraying copper based products such as copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50 gm/20 litres water or Isacop 50WP at a rate of 60 g/20 litres of water) once initial symptoms are observed.
Justification	Powdery mildew disease poses a threat to Crotalaria in all the major production areas. The disease is severe because the pathogen produces abundant spores which cover leaves reducing the plants photosynthetic area. This causes significant yield loss both in terms of quantity and quality. Integrated Disease Management is an environmental friendly approach to disease control and alleviates yield loss due to disease damage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars and meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer

	• Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Undertake applied and adaptive research to validate and release improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices. • Have well organized farmer groups and networks. • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted.
Partners/stakeholders for scaling up and their roles	• KALRO to continua undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • PCPB to promote registration of fungicides for management of the disease and regulate the use of pesticides • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega,
Counties where TIMPs will be upscaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Limited number of extension staff • Lack of Crotalaria innovation platforms to facilitateinteraction of farmers with relevant stakeholders.

	• Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	• Disseminate and promote integrated disease management practices and safe use of pesticides • Establish spray teams/champions • Support extension services • Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	• Successful scaling up is possible if diverse value chain stakeholders collaborate in an innovation platform
	• Adoption of good agricultural practices by the producers is key in management of the diseases • IDM is environment friendly and the chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem.
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality. • Farmers' willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than

adoption and scaling up	men • Women and youth have limited access to education, trainingand extension services than men • Women have limited access to agro-vets as they sometimescannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge • Women might have limited knowledge on integrated management of powdery mildew
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to stable markets for Crotalaria
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access agro-vets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Some of the management options are ready for upscaling 2-Some management options require validation e.g the performance of new varieties need to be established across the counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata, Harun Odhiambo, Mercyline Orayo and Christine Ndinya
Partner organizations	ICRAF, CABI, KEPHIS Extension service providers, CGIAR, NGOs

Research Gaps:

1. Explore Bio-control options for the disease
2. Explore the use of ITKs in disease management at different stages of the disease.

2.6.7.2 TIMP name	**Integrated Management of Bacterial blight disease in Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of 40% due to Crotalaria infestation by the disease
What is it? (TIMP description)	Integrated management of Bacterial blight consists of various approaches that help to break the disease cycle. They cultural management and chemical control. **Cultural practices**: • Use of certified seed • Practicing crop rotation with non-legume crops for 3-4 years. • Uprooting and destroying infected plants/volunteers by burying deeply. • Disinfecting farm tools in jik solution (50ml : litre) • Avoidance of working in wet fields will be validated **Chemical management**: • To suppress the disease, spray copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50gm/20litres water or Isacop 50WP at a rate of 60g/20litres of water) • Get other control products from the PCPB (www.pcpb.or.ke) list of registered pest control products, and use them according to the manufacturer's instructions.
Justification	Integrated Disease Management is an environmental friendly approach that enables the control of the disease through control of vectors and cultural practices that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks

	• Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Carry out applied and adaptive research to validate andrelease improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Limited number of extension agents • Lack of Crotalaria innovation platforms to facilitate interaction of farmers with relevant stakeholders • Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	• Establish Crotalaria innovation platforms • Dissemination of integrated disease management practices and safe use of pesticides in Crotalaria production • Dissemination of agronomic practices.
Lessons learned in up scaling, if any	• More than one approach is used in management of major diseases • IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage

	farmers to participate in the innovation process and the facilitation of experimentation among farmer communities inthe evaluation of the technology enhances technologyadoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	• Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPE)
Gender related opportunities	• Young male and female youth may be employed to monitor (disease scouting) and identification. • Spraying of Crotalaria to control Bacterial blight will create employment opportunities for young male youths
VMG issues and concerns in development, dissemination adoption and scaling up	The management practices reduce the production costs therefore VMG's can afford to produce Crotalaria
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**References:** 1. CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-	Ready for upscaling

requires validation, 3-requires further research)	
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata., Harun Odhiambo, Daniel Mutisya, Mercyline Orayo and Christine Ndinya
Partner organizations	Extension service providers, ICRAF, CABI, CGIAR

2.6.8 Integrated Management of Crotalaria Pests

2.6.8.1 TIMP name	**Integrated Management of Root Knot nematodes in Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of up to 25.6% due to root knot nematodes
What is it? (TIMP description)	Root knot nematodes affecting Crotalarias are controlled through cultural management practises and chemical control; **Cultural practices** • Crop rotation with non-leguminous crops i.e. crops in the grass family for 4-6 seasons. • Avoidance of surface run off as it spreads the pest to non-infected areas, uprooting affected plants and burying. • Soil solarization during dry months of the year on severely affected fields. • Cleaning of farm tools and equipment's after use • Incorporate Tithonia or Mexican marigold as green manure into the infested soil during planting **Biological control** • Drench infested soil with neem based products e.g. Nimbecidine at a rate of 60ml/20L **Chemical management** • Drench with *Trichoderma* spp based biopesticides in the rooting media.e.g.Trianum P at a rate of 45g/15L of water

Justification	Nematodes cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the nematode is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages with Crotalaria stakeholders • Undertake applied and adaptive research to validate and release improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continue undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • Farmers/Farmer Groups to adopt these technologies

	• County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be upscaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPE)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) • Spraying of the crop will create employment opportunities for young male youths
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as credit and pest control products • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to pest management information • There is low adoption by VMGs due lack of awareness • VMG may have a challenge in utilization of spraying equipment
VMG related opportunities	• Opportunities for unemployed rehabilitated male youths exist in pest scouting and cotton spraying programmes
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO

	Ruth Amata., Miriam Otipa., Harun Odhiambo, Mercyline Orayo and Christine Ndinya
Partner organizations	Extension service providers, CGIAR's, NGOs, County governments, Help in the dissemination of the technology,

Research Gaps:

3. Explore the use of ITKs in pest management
4. Explore the use of Trichoderma based products for biological control of nematodes

2.6.8.2 TIMP name	**Integrated Management of Aphids**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids infestation causes up to 70% yield loss on Crotalaria
What is it? (TIMP description)	This is an integrated approach of various control methods suppress the aphids below economic injury levels. **Cultural Control** • Prepare land well and apply 10 kg CAN/acre and 14 kgs/acre DAP to increase plant vigour • Control ants by ploughing and flooding the field to destroy the colonies, expose eggs and larvae to predators • Conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grass hoppers and spiders) by planting lantana hedges to act as breeding grounds for predators • Rotate with non-host crops e.g. maize, upland rice, sorghum, okra, sugarcane, and sunflower to prevent build-up of population. Avoid alternate host crops such as beans, lucerne, pigeon pea • Remove heavily infested plant parts and destroy by burning • Apply neem based products (e.g. neem oil 40ml/20lts of water, Achook) 2 times/month • Spray with soapy water solution (mix 1 tablespoon of teepol detergent with 4 lts of water or use strong jet of water to wash off aphids **Chemical Control** Use only pest control products recommended by Pest Control Products Board (PCPB) such as: • Use Danadim Blue 40 EC (Dimethoate 400 g/L) • Duduthrin 1.75 EC *(Lambdacyhalothrin 17.5 g/L)* • Spray using Atom or Decis at the rate of 10-15mls/20lts of water
Justification	Aphid causes direct damage by sucking sap from plant tissues, leading to deformation, reduced plant height with few flowers and

	shrivelled pods. Aphids cause considerable reduction in yield and lower the leaf quality of Crotalaria. Losses of above 20-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that Crotalaria is consumed widely. The combination of cultural and bio-control and biopesticides is relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in pest management • PCPB to promote registration of bio-insecticides for integrated pest management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega

Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets than men

	• Women have less access to agricultural information, technology and knowledge such as integrated management of Crotalaria aphids • Men dominant most decisions at the household and community levels
Gender related opportunities	Opportunities for youths exists in spraying the crop
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets where they could access pesticides as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E. Case studies/ profiles of success stories	
Success stories	• This is the first time the information is being rolled out.
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	1-ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO: Otipa M., R. Amata, Odhiambo H. Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on aphids identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of Aphid

- Determine the effects of aphid on the yield, quality and implication on economic returns for the farmer

2.6.8.3 TIMP name	**Integrated Management of Desert locust (*Schistocerca gregaria*)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	90% yield loss occasioned by feeding on foliage which occur in swarm of 5-20 million hoppers.
What is it? (TIMP description)	Integrated management of desert locust is a regional program involving multi-sectoral efforts as follows; • A global early warning system of preventive and control of DL is in place. Kenya is a member of Desert Locust Control Organization of Eastern and Central Africa (DLCO-EA). • DLCO-EA uses remote sensing technology and ground surveys to identify and control desert locusts (DL) in their breeding sites. It uses satelite imagery for the identification of potential breeding sites and locust infestations. • Prevention requires a collective effort across regions. • Scouting and control of DL in recession (traditional breeding) regions will prevent infestation in invation (non-traditional) regions • Scouting should be synchronized with early warning systems reports from FAO • Spray hopper bands using Metarhizium anisopliae based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real metarhizium OD (rate 200ml/ ha) among others. Spray at intervals of 3 - 14 days depending on risk of pest damage • Spray with Chlorpyrifos ULV based products like Mursban 480 EC (rate 75ml/20lts water), Agropyrifos 48 EC (20ml/20lts water), Regulator 450 EC (20mls/20lts water), Gradomete R 480 EC. (rate is 1 ltr/ha) • Spray with Fenitrohion based products like Delta 1.01% Dust, Sumicombi 1.8% Dust, Sumithion super. (rate of 1ltr/ha)
Justification	Desert locust cause devastating total vegetative loss of many crops which calls for urgent action by the Ministry of Agriculture and all stakeholders in the region to prevent crop loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers, Extension agents
Approaches to be used in dissemination	• Agricultural shows • MoA/Extension officers • Farmer research networks

	• Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	Need for farmer involvement helps in test evaluation and up scaling of what they learn in the process.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM. • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited finances to purchase pesticides • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge for instance they might not have knowledge of integrated management of Migratory locust
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to improved livelihoods
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop • Increased production leading to improved livelihoods of VMGs
E. Case studies/ profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	

1-Ready for up scaling 2-Requires validation 3-Requires further research	1-ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO-Katumani: M Otipa., R. Amata, Odhiambo H. and Ndinya C.
Partner organizations	Universities, ICIPE, ICRISAT, FAO, Dudutech, Real IPM

Research Gaps

- Capacity building on management of desert locusts
- Validation of biopesticides and synthetic pesticides in the management of desert locusts

2.6.8.4 TIMP name	**Integrated management of Cut worms on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cutworms cause up to 100% damage on Crotalaria seedlings
What is it? (TIMP description)	Integrated cutworm management consist of various approaches to prevent grain damage. **Cultural practises** • Ploughing exposes caterpillars to predators and to desiccation by the sun. • Prepare field and vegetation and weeds destroyed 14 days before planting • Delaying transplanting slightly until the stems are too wide for the cutworm to encircle and/or too hard for it to cut may reduce cutworm damage. • Hand picking of caterpillars at night by torch or very early morning before they return into the soil is useful at the beginning of the infestation. • Flooding of the field for a few days before sowing or transplanting **Biological management**

	• Use repellent neem extract 3 times at weekly intervals • Use of ash on the seedbed • Use of molasses at the base of each plant
Justification	Cut worms cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the cut worm is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-100% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer • Accessibility of the TIMP by the farmers
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	

Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women farmers might not be aware of the Integrated management of cutworms • Women have less access to agricultural information, technology and knowledge

	• Women and youth have limited access to credit facilities for them to purchase inputs • Women and youth have limited access to education, training and extension services than men • Women dominate in the production of Crotalaria therefore there is need to ensure gender balance during trainings • The application of chemical to spray is usually associated with men
Gender related opportunities	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of Crotalaria cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling
G: Contacts	

Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R. Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on Cut worm identification and management
- Validation of biopesticides and synthetic pesticides in the management of cut worm
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer

2.6.8.5 TIMP name	**Integrated Management of Thrips on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Flower thrips cause up to 20-60% yield loss on Crotalaria
What is it? (TIMP description)	Integrated management (IPM) of thrips involves the use of a combination of cultural, biological and chemical control methods. These are; **Cultural Control** • Maintain a healthy crop as it will tolerate thrips and keep the field weed free • Avoid planting new crop near an existing infected field • Mulch fields as this helps reduce thrips population • Use overhead irrigation where possible to reduce spread of thrips • Remove and destroy volunteer plants and debris that may harbour thrips • Uproot heavily infested plant material and burn • Apply soapy sprays (mix 5 teaspoon full of soap powder or chopped bar soap with cold water and dissolve and spray on

	the infested plants • Use blue sticky cardboard traps to attract thrips. **Biological control** • Apply biocontrol agents e.g Beauvitech WP (Beauveria bassiana) or Bio-Power 1.5L (Beauveria bassiana), or Botanigard ES (Azadirachtin), • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). **Chemical Control** • Spray with Spinosad based products eg tracer 480 SC at 4mls per 20lts of water or lambda cyhalothrin products at 7ml per 20l of water or duduthrin at 65mls per 20l of water or Karate at 20gms/ 20l • Use synthetic insecticides with PHI of 3 days or less since garden pea is harvesting at very short intervals.
Justification	Thrips cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the thrips are severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms

	• Farmer field and business schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required. • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer. • Accessibility of the TIMP by the farmers.
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	None of the counties have any experience on the technology as this pest has just arrived in the eastern Africa region.
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions

	• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPEs)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) • Spraying of the crop during the bollworm control will create employment opportunities for young male youths
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as credit and pest control products • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to pest management information • There is low adoption by VMGs due lack of awareness • VMG may have a challenge in utilization of spraying equipment.
VMG related opportunities	• Opportunities for unemployed rehabilitated male youths exist in pest scouting and cotton spraying program.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-	1-Ready for upscaling

requires validation, 3-requires further research)	
G: Contacts	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R., Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on thrip identification and management
- Validation of biopesticides and synthetic pesticides in the management ofthrips
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer

2.6.8.6 TIMP name	**Integrated management of pod borer on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Pod sucking cause up to 100% yield loss on Crotalaria
What is it? (TIMP description)	Integrated management of Pod sucking bugs consist of various approaches to prevent plant damage. **Cultural Control** • Bugs can be collected by hand regularly and killed, especially during flowering and pod formation. • Conserve natural enemies such as assassin bugs, spiders, praying mantises and ants. **Biological control** • Spray Neem products in the morning when the immature stages are exposed.
Justification	Pod sucking bugs cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the bug infestation is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated

	Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required. • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer. • Accessibility of the TIMP by the farmers.
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	-Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain

Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land and credit than men to purchase inputs such as pesticides • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community levels including pest control • Women have limited access to markets as they sometimes cannot travel to far markets outlets to source for Crotalaria inputs
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production of the crop leading to increased incomes

VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to spiny brown bugs information and their management strategies • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling 2-requires validation 3-Requires further research
G: Contacts	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa., M., Amata R., Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on pod sucking bugs identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of pod sucking bugs
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmers

Integrated Management of Crotalaria Diseases

2.6.7.1 TIMP name	**Integrated Management of powdery mildew disease in Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 21% due to Crotalaria infection by the disease
What is it? (TIMP description)	Integrated management of powdery mildew consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.**Cultural management options**: • Plant early using certified seeds. • Practice crop rotation with non-legumes for a period of 2-3 seasons. • Uproot and destroy severely affected plants, including weeds and volunteer crops by burying them deeply. • Do not walk through your field during wet weather to prevent the spread of the disease from one plant to another. • Ensure that field sanitation and hygiene practices areadhered to by collecting and disposing infected plants by deeply burying them. **Chemical management options:** • Spraying copper based products such as copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50 gm/20 litres water or Isacop 50WP at a rate of 60 g/20 litres of water) once initial symptoms are observed.
Justification	Powdery mildew disease poses a threat to Crotalaria in all the major production areas. The disease is severe because the pathogen produces abundant spores which cover leaves reducing the plants photosynthetic area. This causes significant yield loss both in terms of quantity and quality. Integrated Disease Management is an environmental friendly approach to disease control and alleviates yield loss due to disease damage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars and meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs

	• Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Undertake applied and adaptive research to validate and release improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices. • Have well organized farmer groups and networks. • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted.
Partners/stakeholders for scaling up and their roles	• KALRO to continua undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • PCPB to promote registration of fungicides for management of the disease and regulate the use of pesticides • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega,
Counties where TIMPs will be upscaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Limited number of extension staff • Lack of Crotalaria innovation platforms to facilitateinteraction of farmers with relevant stakeholders. • Farmers may not implement some of the practices e.g. Crop

	rotation small farms and limited economic resources.
Suggestions for addressing the challenges	• Disseminate and promote integrated disease management practices and safe use of pesticides • Establish spray teams/champions • Support extension services • Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	• Successful scaling up is possible if diverse value chain stakeholders collaborate in an innovation platform
	• Adoption of good agricultural practices by the producers is key in management of the diseases • IDM is environment friendly and the chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem.
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality. • Farmers' willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to agro-vets as they sometimes

	cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge • Women might have limited knowledge on integrated management of powdery mildew
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to stable markets for Crotalaria
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access agro-vets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Some of the management options are ready for upscaling2-Some management options require validation e.g the performance of new varieties need to be established across the counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata, Harun Odhiambo, Mercyline Orayo and Christine Ndinya
Partner organizations	ICRAF, CABI, KEPHIS Extension service providers, CGIAR, NGOs

Research Gaps:

3. Explore Bio-control options for the disease
4. Explore the use of ITKs in disease management at different stages of the disease.

2.6.7.2 TIMP name	Integrated Management of Bacterial blight disease in Crotalaria
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of 40% due to Crotalaria infestation by the disease
What is it? (TIMP description)	Integrated management of Bacterial blight consists of various approaches that help to break the disease cycle. They cultural management and chemical control. **Cultural practices**: • Use of certified seed • Practicing crop rotation with non-legume crops for 3-4 years. • Uprooting and destroying infected plants/volunteers by burying deeply. • Disinfecting farm tools in jik solution (50ml : litre) • Avoidance of working in wet fields will be validated **Chemical management**: • To suppress the disease, spray copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50gm/20litres water or Isacop 50WP at a rate of 60g/20litres of water) • Get other control products from the PCPB (www.pcpb.or.ke) list of registered pest control products, and use them according to the manufacturer's instructions.
Justification	Integrated Disease Management is an environmental friendly approach that enables the control of the disease through control of vectors and cultural practices that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials

	• Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Carry out applied and adaptive research to validate andrelease improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Limited number of extension agents • Lack of Crotalaria innovation platforms to facilitate interaction of farmers with relevant stakeholders • Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	• Establish Crotalaria innovation platforms • Dissemination of integrated disease management practices and safe use of pesticides in Crotalaria production • Dissemination of agronomic practices.
Lessons learned in up scaling, if any	• More than one approach is used in management of major diseases • IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities inthe evaluation of the technology enhances technologyadoption • IDM approaches are knowledge intensive and location- specific,

	farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	• Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPE)
Gender related opportunities	• Young male and female youth may be employed to monitor (disease scouting) and identification. • Spraying of Crotalaria to control Bacterial blight will create employment opportunities for young male youths
VMG issues and concerns in development, dissemination adoption and scaling up	The management practices reduce the production costs therefore VMG's can afford to produce Crotalaria
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**References:** 2. CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	

Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata., Harun Odhiambo, Daniel Mutisya, Mercyline Orayo and Christine Ndinya
Partner organizations	Extension service providers, ICRAF, CABI, CGIAR

2.6.8 Integrated Management of Crotalaria Pests

2.6.8.1 TIMP name	**Integrated Management of Root Knot nematodes in Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of up to 25.6% due to root knot nematodes
What is it? (TIMP description)	Root knot nematodes affecting Crotalarias are controlled through cultural management practises and chemical control; **Cultural practices** • Crop rotation with non-leguminous crops i.e. crops in the grass family for 4-6 seasons. • Avoidance of surface run off as it spreads the pest to non-infected areas, uprooting affected plants and burying. • Soil solarization during dry months of the year on severely affected fields. • Cleaning of farm tools and equipment's after use • Incorporate Tithonia or Mexican marigold as green manure into the infested soil during planting **Biological control** • Drench infested soil with neem based products e.g. Nimbecidine at a rate of 60ml/20L **Chemical management** • Drench with *Trichoderma* spp based biopesticides in the rooting media.e.g.Trianum P at a rate of 45g/15L of water
Justification	Nematodes cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the nematode is severe and not controlled plants become greatly reduced in size and yield. Losses

	of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages with Crotalaria stakeholders • Undertake applied and adaptive research to validate and release improved Crotalaria varieties • Create a platform for interaction of Crotalaria value chain stakeholders • Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continue undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • Farmers/Farmer Groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators

	• Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be upscaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	

Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPE)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) • Spraying of the crop will create employment opportunities for young male youths
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as credit and pest control products • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to pest management information • There is low adoption by VMGs due lack of awareness • VMG may have a challenge in utilization of spraying equipment
VMG related opportunities	• Opportunities for unemployed rehabilitated male youths exist in pest scouting and cotton spraying programmes
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Ruth Amata., Miriam Otipa., Harun Odhiambo, Mercyline Orayo and Christine Ndinya

Partner organizations	Extension service providers, CGIAR's, NGOs, County governments, Help in the dissemination of the technology,

Research Gaps:

5. Explore the use of ITKs in pest management
6. Explore the use of Trichoderma based products for biological control of nematodes

2.6.8.2 TIMP name	**Integrated Management of Aphids**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids infestation causes up to 70% yield loss on Crotalaria
What is it? (TIMP description)	This is an integrated approach of various control methods suppress the aphids below economic injury levels. **Cultural Control** • Prepare land well and apply 10 kg CAN/acre and 14 kgs/acre DAP to increase plant vigour • Control ants by ploughing and flooding the field to destroy the colonies, expose eggs and larvae to predators • Conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grass hoppers and spiders) by planting lantana hedges to act as breeding grounds for predators • Rotate with non-host crops e.g. maize, upland rice, sorghum, okra, sugarcane, and sunflower to prevent build-up of population. Avoid alternate host crops such as beans, lucerne, pigeon pea • Remove heavily infested plant parts and destroy by burning • Apply neem based products (e.g. neem oil 40ml/20lts of water, Achook) 2 times/month • Spray with soapy water solution (mix 1 tablespoon of teepol detergent with 4 lts of water or use strong jet of water to wash off aphids **Chemical Control** Use only pest control products recommended by Pest Control Products Board (PCPB) such as: • Use Danadim Blue 40 EC (Dimethoate 400 g/L) • Duduthrin 1.75 EC *(Lambdacyhalothrin 17.5 g/L)* • Spray using Atom or Decis at the rate of 10-15mls/20lts of water
Justification	Aphid causes direct damage by sucking sap from plant tissues, leading to deformation, reduced plant height with few flowers and

	shrivelled pods. Aphids cause considerable reduction in yield and lower the leaf quality of Crotalaria. Losses of above 20-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that Crotalaria is consumed widely. The combination of cultural and bio-control and biopesticides is relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in pest management • PCPB to promote registration of bio-insecticides for integrated pest management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega

Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets than men • Women have less access to agricultural information, technology and knowledge such as integrated management of Crotalaria aphids

	• Men dominant most decisions at the household and community levels
Gender related opportunities	Opportunities for youths exists in spraying the crop
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets where they could access pesticides as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E. Case studies/ profiles of success stories	
Success stories	• This is the first time the information is being rolled out.
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	1-ready for up scaling
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO: Otipa M., R. Amata, Odhiambo H. Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on aphids identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of Aphid
- Determine the effects of aphid on the yield, quality and implication on economic returns for the farmer

2.6.8.3 TIMP name	Integrated Management of Desert locust (*Schistocerca gregaria*)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	90% yield loss occasioned by feeding on foliage which occur in swarm of 5-20 million hoppers.
What is it? (TIMP description)	Integrated management of desert locust is a regional program involving multi-sectoral efforts as follows; • A global early warning system of preventive and control of DL is in place. Kenya is a member of Desert Locust Control Organization of Eastern and Central Africa (DLCO-EA). • DLCO-EA uses remote sensing technology and ground surveys to identify and control desert locusts (DL) in their breeding sites. It uses satelite imagery for the identification of potential breeding sites and locust infestations. • Prevention requires a collective effort across regions. • Scouting and control of DL in recession (traditional breeding) regions will prevent infestation in invation (non-traditional) regions • Scouting should be synchronized with early warning systems reports from FAO • Spray hopper bands using Metarhizium anisopliae based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real metarhizium OD (rate 200ml/ ha) among others. Spray at intervals of 3 - 14 days depending on risk of pest damage • Spray with Chlorpyrifos ULV based products like Mursban 480 EC (rate 75ml/20lts water), Agropyrifos 48 EC (20ml/20lts water), Regulator 450 EC (20mls/20lts water), Gradomete R 480 EC. (rate is 1 ltr/ha) • Spray with Fenitrohion based products like Delta 1.01% Dust, Sumicombi 1.8% Dust, Sumithion super. (rate of 1ltr/ha)
Justification	Desert locust cause devastating total vegetative loss of many crops which calls for urgent action by the Ministry of Agriculture and all stakeholders in the region to prevent crop loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers, Extension agents
Approaches to be used in dissemination	• Agricultural shows • MoA/Extension officers • Farmer research networks • Mass media – Agricultural programs

	• Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	Need for farmer involvement helps in test evaluation and up scaling of what they learn in the process.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM. • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate

	• Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	
Estimated returns	
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Women and youth have limited finances to purchase pesticides • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge for instance they might not have knowledge of integrated management of Migratory locust
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to improved livelihoods
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop • Increased production leading to improved livelihoods of VMGs
E. Case studies/ profiles of success stories	
Success stories	-
Application guidelines for users	CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation	1-ready for up scaling

3-Requires further research	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead Organization and Scientist(s)	KALRO-Katumani: M Otipa., R. Amata, Odhiambo H. and Ndinya C.
Partner organizations	Universities, ICIPE, ICRISAT, FAO, Dudutech, Real IPM

Research Gaps

- Capacity building on management of desert locusts
- Validation of biopesticides and synthetic pesticides in the management of desert locusts

2.6.8.4 TIMP name	**Integrated management of Cut worms on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cutworms cause up to 100% damage on Crotalaria seedlings
What is it? (TIMP description)	Integrated cutworm management consist of various approaches to prevent grain damage. **Cultural practises** • Ploughing exposes caterpillars to predators and to desiccation by the sun. • Prepare field and vegetation and weeds destroyed 14 days before planting • Delaying transplanting slightly until the stems are too wide for the cutworm to encircle and/or too hard for it to cut may reduce cutworm damage. • Hand picking of caterpillars at night by torch or very early morning before they return into the soil is useful at the beginning of the infestation. • Flooding of the field for a few days before sowing or transplanting **Biological management** • Use repellent neem extract 3 times at weekly intervals • Use of ash on the seedbed • Use of molasses at the base of each plant

Justification	Cut worms cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the cut worm is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-100% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer • Accessibility of the TIMP by the farmers
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production

Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women farmers might not be aware of the Integrated management of cutworms • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to credit facilities for them to purchase inputs • Women and youth have limited access to education, training and extension services than men

	• Women dominate in the production of Crotalaria therefore there is need to ensure gender balance during trainings • The application of chemical to spray is usually associated with men
Gender related opportunities	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of Crotalaria cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to agricultural knowledge and extension services such as integrated management of cutworms leading to low adoption • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling
G: Contacts	

Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R. Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on Cut worm identification and management
- Validation of biopesticides and synthetic pesticides in the management of cut worm
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer

2.6.8.5 TIMP name	**Integrated Management of Thrips on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Flower thrips cause up to 20-60% yield loss on Crotalaria
What is it? (TIMP description)	Integrated management (IPM) of thrips involves the use of a combination of cultural, biological and chemical control methods. These are; **Cultural Control** • Maintain a healthy crop as it will tolerate thrips and keep the field weed free • Avoid planting new crop near an existing infected field • Mulch fields as this helps reduce thrips population • Use overhead irrigation where possible to reduce spread of thrips • Remove and destroy volunteer plants and debris that may harbour thrips • Uproot heavily infested plant material and burn • Apply soapy sprays (mix 5 teaspoon full of soap powder or chopped bar soap with cold water and dissolve and spray on the infested plants

	• Use blue sticky cardboard traps to attract thrips. **Biological control** • Apply biocontrol agents e.g Beauvitech WP (Beauveria bassiana) or Bio-Power 1.5L (Beauveria bassiana), or Botanigard ES (Azadirachtin), • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). **Chemical Control** • Spray with Spinosad based products eg tracer 480 SC at 4mls per 20lts of water or lambda cyhalothrin products at 7ml per 20l of water or duduthrin at 65mls per 20l of water or Karate at 20gms/ 20l • Use synthetic insecticides with PHI of 3 days or less since garden pea is harvesting at very short intervals.
Justification	Thrips cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the thrips are severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS)

	• Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required. • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer. • Accessibility of the TIMP by the farmers.
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	None of the counties have any experience on the technology as this pest has just arrived in the eastern Africa region.
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality

	• Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as credit • Women and youth have limited access to pest management training and extension services • Due to their social status women and youth are often excluded from decision making in development and dissemination activities • Youth applying synthetic pesticides should always wear Personal Protective Equipment (PPEs)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) • Spraying of the crop during the bollworm control will create employment opportunities for young male youths
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as credit and pest control products • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to pest management information • There is low adoption by VMGs due lack of awareness • VMG may have a challenge in utilization of spraying equipment.
VMG related opportunities	• Opportunities for unemployed rehabilitated male youths exist in pest scouting and cotton spraying program.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	Centre Director KALRO Kabete,

	Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa M., Amata R., Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on thrip identification and management
- Validation of biopesticides and synthetic pesticides in the management ofthrips
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmer

2.6.8.6 TIMP name	**Integrated management of pod borer on Crotalaria**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Pod sucking cause up to 100% yield loss on Crotalaria
What is it? (TIMP description)	Integrated management of Pod sucking bugs consist of various approaches to prevent plant damage. **Cultural Control** • Bugs can be collected by hand regularly and killed, especially during flowering and pod formation. • Conserve natural enemies such as assassin bugs, spiders, praying mantises and ants. **Biological control** • Spray Neem products in the morning when the immature stages are exposed.
Justification	Pod sucking bugs cause considerable reduction in yield and lower the grain quality of Crotalarias. Where the bug infestation is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that the grain consumed very widely in

	Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	Producers, Exporters, Researchers, Academia, Farmers
Approaches used to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages are required. • Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer. • Accessibility of the TIMP by the farmers.
Partners/stakeholders for scaling up and their roles	KALRO to continually undertake research in pest management PCPB to promote registration of insecticide for pest management Farmers/farmer groups to adopt the technologies County governments, central governments for development of enabling policies and create awareness. Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	-Kakamega
Counties where TIMPs will be up scaled	Nyamira, Vihiga and all counties with agro-ecological settings suitable for Crotalaria production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Crotalaria and losses attributed to them • Poor linkages among stakeholders in Crotalaria value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options

	• Establish Crotalaria innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land and credit than men to purchase inputs such as pesticides • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community levels including pest control • Women have limited access to markets as they sometimes cannot travel to far markets outlets to source for Crotalaria inputs
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production of the crop leading to increased incomes
VMG issues and concerns in development and dissemination	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services

	• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to spiny brown bugs information and their management strategies • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling 2-requires validation 3-Requires further research
G: Contacts	
Contacts	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075
Lead organization and scientists	KALRO Otipa., M., Amata R., Odhiambo H., Orayo M. and Ndinya C.
Partner organizations	ICIPE, ICRISAT, CABI, Dudutech, Real IPM

Research Gaps

- Capacity building on pod sucking bugs identification and management
- Validation of bio-pesticides and synthetic pesticides in the management of pod sucking bugs
- Determine the effects of spider mites on the yield, quality and implication on economic returns for the farmers

7.7 AIVs Crop Health Slender Leaf

TIMP Name	Integrated Weed Management
Crop managementnt practices	Management practices

A: Description of the technology, innovation or management practice

Problem addressed	Weeds reduce profitability in AIVs production system. They compete for nutrients, soilmoisture and space with the crop and also harbor insect pests and create an environment conducive for disease occurrence. This adds costs to production. Major weeds in AIVsproduction include grass weeds such as couch, kikuyu grass, star grass and annual weeds such as black jack, gallant soldier, mexican marigold and wandering jew. Different weeds require various strategies for effective control, hence producers should combine two or more of the methods to management weeds. Significant yield losses in AIVs production are attributed to poor weed management. Proper weed management is necessary to increase productivity

Common weeds affecting AIVs production

Wandering Jew (*Commelina Benghalensis* L.) Source Hottensiah Mwangi

Double thorn (*Oxygonum sinuatum* (Meisn.)Dammer associating with crows foot (*dactyloctenium aegyptium*) and *Ragwort* (*Senecio discifolia* Oliv.) Source Hottensiah Mwangi

		
	Gallant soldier (*Galinsoga parviflora*Cav.)	Blackjack (*Bidens pilosa* L.)
		
	Digitaria veluntina (Forssk.)P. Beauv.	Wild finger millet (*Eleusine indica* (L.)Gaertn.)

		
	Purslane (*Portulca oleraceae L.*) Source Hottensiah Mwangi	*Late weed* (*Trichodesma zeylanicum*) amonggrass weeds Source Hottensiah Mwangi
		
	Goat weed (*Ageratum conyzoides* L.)	Sow thistle (*Sonchus oleraceus* L.)
		
	Terere (*Amaranthus graecisans*)	Oxalis (*Oxalis latifolia* H.B.K)

		
	Chickweed *(Stellaria media* (L.) Vill.	Wild lettuce (*Launaea cornuta* (Oliv.&Hiern))
		
	Parthenium (*Parthenium hysterophorus*)	Thorn apple (*Datura stramonium* L.)

		
	Asthma weed (*Euphobia hirta* L.)	Wild raddish (*Raphanus raphanistrum*)
		
	Starbur (*Acanthospermum hispidum* DC.)	Eshaaga (*Eracustrum arabicum* Fisch.&Mey.)
		
	Chinese Lantern (*Nicadra physaloides*)	Tar vine (*Boerhavia diffusa L.*)
		
	Nutsedge (*Cyperus rigidifolius* Steud.)	Couch grass (*Digitaria abyssinica*)

	Source Hottensiah Mwangi	Source Hottensiah Mwangi
What is it?(TIMP description)	Integrated weed management (IWM) is using of several weed approaches such as preventive, physical control, biological control, use of biodegradable mulch, cultural, mechanical and chemical control the management of weeds . Physical control is the removal of weeds manually or mechanical means, such as hand weeding or mowing. Biological control is where you graze by big animals. Chemical control is where appropriate herbicides are used to control weeds. Cultural control includes the practice of crop rotation since various crops may influence the diversity and abundance of particular weed flora. Select robust growing varieties that cover the soil and suppress weeds in rotation. Mechanical weed management includes use of farm implements e.g use of a motorized knap weeder, which does the work much faster and is less tedious. Chemical weed management involves use of pre-emergence selective herbicides and or post- emergence selective herbicides. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks).	
Justification	The wide diversity of weeds affecting AIVs cannot be effectively managed by one approach such as manual approaches commonly used by majority of farmers. Whereas this is effective, it is time consuming and labour intensive. Whereasmanual weeding could be effective, it may also be ineffective when carried out under wet conditions; all weeds maybe apparently replanted. Therefore regrowth becomes a big problem. AIVs producers should therefore selectone or more approaches to keep weeds under control.  Weeds left in the intra row when using plough with draught animals can be uprooted manually. 	

	 Hand weeding & Back breaking labour burden in common weeding practice weeded field  Identify the weed diversity and densityto make appropriate control measure
where already promotedif any	Laikipia, Nyeri
Countieswhere TIMPs will be upscaled	Laikipia and Nyeri
Challenge s in developme nt and dissemination	High cost of herbicides Inadequate knowledge and information on which herbicides to use and when to usethem Myths on appropriateness of using herbicides
Suggestio n for addressingthe challenges	Promotion of the product by conducting demos and field days and involvement ofthe stakeholder e.g. agro-chemical company Develop and disseminate information to various stakeholders Training on integrated approaches using available methods, including appropriateherbicides and their use of herbicides – safety
Lesson learned inup scalingif any	That integrated approaches of weed management are more effective than use of onecontrol method and is safe on environmentally friendly. Continue use of herbicide is environmental, health and social hazard.

Social, environmental, policy andmarket conditionsnecessary for developme nt and up-scaling	Train on understanding the working of an integrated weed management.Have an environmental and safety plan when using herbicides Address the environmental and social concerns related to use of agrochemicals. A functional agrodealer network to supply the products when required by the farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basiccosts	Ksh 4000
Estimatedreturns	KSH 1000 per acre
Gender issues and concerns in development dissemination, adoption and scaling up	Women and youth have limited access to production resources such as land, capital to purchase some of the inputs used for IWM Women work is complicated by their multiple roles they do such as such domestic roles Women and youth have limited access to education, training and extension services Women have less access to agricultural information, technology and knowledge on IWM Women and youth have less access to knowledge and information on IWM Use of IWM technology can reduce labour from manual weeding and save time for other activities for women and children
Gender related opportunities	Women and youth to generate income from weeding Women and youth to generate income from agro dealer business Women and youth to generate income by starting cortege value addition factories due to enhanced yield There will be improved food security and nutrition from for women There will be increased job security for women and youth by spraying herbicides There will be increased production since the weed competes with plants leading to low production
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	VMG groups could have limitations in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes. VMG have less access to extension training as they are not given equal opportunities VMG have less access to knowledge and information on IWM VMG have less access to capital to purchase herbicides
VMG related opportunities	VMG to generate income from agro dealer business VMG to generate income by starting cortege value addition factories due to enhanced yield There will be increased production leading to increase food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Successstories	

Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires	Ready for up scaling
validation;3. Requiresfurther research)	
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organizati on andscientists	KALRO , Kabete Dr Hottensiah Mwangi, Dr Jedidah M. Maina, Charity, W. Muchira, Dr. RuthAmata, Dr Violet Mumanyi
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

Research Gaps:
Determine cost benefits of using motorized knap weeder versus other IWM in AIVs production

3.3. TIMP Name	**Land Preparation Practices to control weeds in AIVs**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	A weed biodiversity infests in AIV cropping systems that contributes to poor crop and yield loss across the agro ecological zones in Kenya.

	 Poorly prepared land Unprepared Land
What is it? (TIMP description)	Land preparation covers a wide range of practices from zero-tillage or minimum tillage through to conventional ploughing using hand hoe, ox plough or tractor. It typically involves (1) plowing to "till" or dig-up, mix, and overturn the soil; (2) harrowing to break the soil clods into smaller mass which exposes weeds seeds from seed banks. Land preparation can be by ridging's which can be done manually or mechanized by use of tillers. It is done during the dry weather when soils are easier to work to make save site for AIVs seeds. We recommended this to be 3-4 weeks before the rain commence. For no till choose appropriate herbicides and follow the manufacturers label and recommendations specific to each herbicide. Apply post emergence on vigorously growing weeds to clear the difficult to control weeds such as couch grass, nut sedges among others. The most common herbicides used is Glyphosate with trade names such as Round up, Glycel, Kausha, weedal.
Justification	Land preparation is important to control weeds and ensure that the AIVs field and ready for planting and also facilitate obtaining a uniform crop depth resulting to almost uniform germination. This enables to minimize yield loss and increase productivity because AIVs are poor competitors. It controls weeds, and provides a soft soil mass suitable for direct seeding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers in all AIVs suitable regions
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Land preparation using pre-emergence in steep areas can lead to soil erosion and herbicides getting to water tables. Train producers on available options using practical demonstrations Participatory field days with farmers groups and stakeholders Provide communication products eg brochures
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, Tractor/Plough service providers, NGOs, Research organization (KALRO, CIAT)

C: Current situation and future scaling up	
Counties where already promoted. if any	Conservation Agriculture/Minimum Tillage for land preparation in laikipia,Nakuru, Tractor ploughing in Nakuru, Laikipia, Trans Nzoia,Bungoma, Bomet, Narok, Nandi, Kakamega
Counties where TIMPs will be	All suitable areas
Upscaled	
Challenges in development and dissemination	• Limited biological knowledge on weeds such as couch grass. • Small land holding limiting tractor mechanization • High cost of using mechanized options
Suggestions for addressing the challenges	• Promotion of the low cost mechanization technologieswhere possible. • Tractor hire service by County and other serviceproviders • Training for land preparation to control weeds under no-till, minimum tillage and farmers practice.
Lessons learned in up scaling, if any	Good land preparation minimises weed infestation, results to increased yield and moisture retention especially where ridging is practiced and weeds sprayed post emergence herbicides.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Land size and topography influences choice of land preparation method to manage weeds. • County tractor subsidy program can help promote mechanization for land preparation. • Use of small hand tractors hould be made accessible, affordable and easier to operate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 4,500 per acre
Estimated returns	6000-7000 Ksh
Gender issues and concerns in development, dissemination, adoption and scaling up	• Use of low cost land preparation technologies that are affordable to women farmers • Promote labour saving technologies to benefit women who are major players on land preparation • Land preparation during dry period to ensure weeds dry up and subsequent operations easier and cheaper. • Early land preparation exposes the pest and diseases to the hot sun hence reduced build up of inoculum • Explore use of herbicides to kill weeds and save labour
Gender related opportunities	• Ensure Opportunities for using low cost, low labour land preparation technologies that does not exclude women.

VMG issues and concerns in development, dissemination, adoption and scaling up  	• High cost of land preparation • Access to the mechanized options for land preparation. • Some management practices such as ConservationAgriculture (CA) is friendly to the VMGs • The project should have provision on training of the youths
VMG related opportunities	• Group land preparation by VMG • There is a business opportunity for the for the youth using low cost mechanization- e.g. ox-ploughs, walking tractors in land preparation service enterprises
E: Case studies/profiles of success stories	
Success stories	Farmers in Embu and Nyeri have realized higher returns after this practice and have attained Lucy Waihiga who
	increased yield from 45-180kg from ¼ acres
Application guidelines for users	The small walking tractors are available in the Countiesand training on use of small equipment and mechanization
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Katumani, KALRO Embu
Lead organization and scientists	KALRO Katumani
Partner organizations	KALRO, CIAT-PABRA, Seed Companies, Mechanization partners e.g. Ikonic, Hello Tractor, Conservation Tillage Network in Nairobi

TIMP Name	**Legume Intercropping System**
Categories (i.e. technology innovation Or management practice)	Innovation Picture **Legume AIVs intercrop**
A: Description of the technology, innovation or management practice	
Problem addresses	Weeds invading the bean fields competiting for resources nutrients, water and space. Planned inter-cropping of beans with other crops - cereal (maize or sorghum) tubers (cassava), bananas, cash crops (coffee) gives returns. Poor intercropping results in low yields attributed to competition for light and nutrients and may lead to increased infestation of pests and diseases. Good intercropping to effectively control weeds **Cowpea finger millet intercrop**

	 requires specific spacing, the right variety of legume depending on growth habit of the intercrop. Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition.
What is it? (TIMP description)	Innovative Legume Intercropping Systems is the application of growing more than one crop in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use. Intercropping systems are defined based on the temporal and spatial arrangements of the crops.There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Innovative AIV intercrop  Cowpea millet-sorghum intercrop
Justification	Cropping of several AIVs plant species together reduces negative effects of amonoculture and thus is commonly employed in ecological agricultural

	systems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is compatible with the principles of balanced agriculture. Intercropping systems provide better soil cover hence reducingweed incidences. Intercropping has important advantages in regard to efficient land use, increasing crop productivity and monetary returns thanks to effective use of various inputs compared to sole cropping. It can significantly increase total productivity as compared to sole cropping thanks to better utilization of water,nutrients and solar energy. Crops in these systems use available resources more efficiently thanks to different rooting and canopy properties which component plants species exploit resources complementary. Intercropping systems can cause more effective use of resources by providing symbiotic nitrogen from legumes, or making available inorganic phosphorus fixed in soil because of lowering of pH via nitrogen fixing legumes. Intercropping systems is a climate adaptation strategy in case of crop failure in mono cropping and is considered as one of the most dependable ways to maintain the sustainability of crop production. It is a risk mitigation strategy by farmersin light of prevailing climate change. Intercropping practices can ensure higher yield as well as productivity and profitability in crops per unit land. Intercropping systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources andprofitable than mono-cropping systems. Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, and color and trapping effects between intercropsinfluence insect or disease situation or their natural enemies. Crop rotation and intercropping practices decrease weed population density and biomass yield Success of intercropping systems over sole cropping can be achieved by careful agronomic manipulations and planning schedules. These manipulations include planting time, plant density, available resources, intercropping patterns, Spatial arrangements, and harvest times.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Conduct demos band the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Altitude areas of 1,500-2,000 above sea level ie Bomet Nakuru, Laikipia, Nyeri, Kirinyaga, Murang'a, Bungoma, Kakamega, Siaya, Trans Nzoia, Uasin Gishu.
Counties where	Nyeri and Laikipia

TIMPs will be up scaled	
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	Facilitation of training of county extension staffs Demos and field days
Lesson learned in up scaling if any	Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promoting in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	Women migtght not be aware that Legume AIVs intercrop is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for Legume AIVs intercrop Need to train, especially women, on how to implement the Legume AIVs intercrop systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs might not be aware of the use Legume AIVs intercrop in weed management VMGs have no finances so they might not have funds to purchase some of the input used for Legume AIVs intercrop Legume AIVs intercrop systems impede mechanization of the production system
VMG related opportunities	System diversification and yield stability will increase food availabilityleading to food and nutrition security at household level Improved income from production and marketing of beans and other crops-

	diversified incomes
E: Case studies/profiles of success stories	
Success stories	Nyamira, Kakamega, Siaya, Trans Nzoia, Uasin Gishu.
Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Require validation
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800,Nairobi
Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi, Dr Jedidah Maina and Charity W. Muchira.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

3.6. TIMP Name	**AIVs Intercropping**
Categories (i.e. technology innovation Or management practice	Management practices
A: Description of the technology, innovation or management practice	
Problem addresses	Low yield production, in AIVs.
	Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing smoother weeds.
What is it? (TIMP description)	Intercropping of AIV is the practice of planting AIVs between other crops between rows such as cereal (maize, millets), tubers (cassava), and bananas. Intercropping must be planned to use space available and smother the weeds.
Justification	Cropping of several plant species together reduces negative effects of a monoculture and thus is commonly employed in ecological agriculturalsystems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is sustainable practice.

	Intercropping has important advantages in regard to efficient land use, It can significantly increase total productivity as compared to sole cropping to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently to different rooting and canopy properties which component plants species to exploit resources complementary. Success of intercropping systems over sole cropping can be achieved by some agronomic manipulations. These manipulations can be plant density, planting time, available resources and intercropping patterns. Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV producer, Seed producers, Extension staff
Approaches used in dissemination	Extension publications (posters/ brochures/leaflets) Partners -NGOs Demonstrations and field days, Agriculture shows/trade fairs and distribution of small sample, farmer participatory evaluations Seeds of Gold, Mass Media – e.g. Mkulimaprogramme, Smart Farmer
Critical/essential factors for successful promotion	Availability of seed, Conduct demos and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective	County extension staffs, NGOs, Private sectors e.g. seed company, AIVs value chain service providers
roles.	
C: Current situation and future scaling up	
Counties where already promoted if any	Altitude area of 1500-2000 meters above sea level Bomet, Nakuru, Laikipia, Nyeri
Counties where TIMPs will beup-scaled	Laikipia and Nyeri
Challenges in development anddissemination	Inadequate AIVs seeds Inadequate information to stakeholders on optimal spacing options for the different varieties for the different AEZ
Suggestion for addressing thechallenges	Train the stakeholders and youths in seed production Conduct demos and field days to demonstrate on benefits of intercropping and also mono cropping correct spacing through use Farmer Field Business School (FFBS) and Agricultural Innovation Platforms (AIP)
Lesson learnt in scaling, if any	Farmers who have learnt of the technology through field days and demos are currently user of the new technology. Alternative method (mechanization - planter) may lessen the work Capacity building and awareness campaign on proper spacing and intercropping are required.
Social, environmental, policyand market	The technology is socially acceptable, good for environment, and the market irs ready for

conditions necessary for -developmentand up-scaling	development and up-scale. The practice minimizes the use pesticides and surface run off since they also act as cover crop
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice although it has a limitation of using herbicides. The weeds get suppressed by the canopy cover.
Estimated returns	Considering the land equivalent ratio the return are expected to be higher in the intercrop being done at subsistence level for foodsecurity. If the focus is business oriented and mechanization is employed it may bring the cost of production lower.
Gender issues and concerns indevelopment, dissemination adoption and scaling up	Women migtght not be aware that AIVs intercropping is a means of a weed control Complexity of the intercropping system can result in increased labour for women Have limited access to agricultural information and extension services hence they might not have information on intercropping Women have limited finances to purchase inputs required for AIVs intercropping .Need to train, especially women, on how to implement the Legume AIVs intercropping systems.
Gender related opportunities	Diversity and yield stability are a major win for the entire household There will be increased food security and nutrition for women and youth There will be increased incomes for women and youth
VMG issues andconcerns in development, dissemination, adoption andscaling up	VMGs might not be aware of the use Legume AIVs intercropping in weed management VMGs have no finances so they might not have funds to purchase some of the input used for AIVs intercropping Legume AIVs itercropping systems impede mechanization of the production system
VMG related opportunities	System diversification and yield stability will increase food availabilityleading to food and nutrition security at household level Improved income from production and marketing of beans and other crops-diversified incomes
Gender issues and concerns indevelopment, dissemination, adoption and scaling up	Operations in row planted with AIVs are easier. Training on optimum training should target majorly women who are the ones who play key role. .
Gender related opportunities	Optimum spacing and row planting opens space for mechanization, which would reduce drudgery this benefiting the women.
VMG issues and concerns in development, dissemination, adoption and scaling up	Information needs on spacing Training of farmers on optimum spacing

VMG related opportunities	Service provision for mechanized planting of beans Extension support to other farmers
E: Case studies/profiles of success stories	
Success stories	Some farmers in Kieni in Nyeri County have moved from 1 bag to 4 bags (90kg bag) Farmers have reported improved soil conditions, reduced runoff and buildup of nutrient loss, soil moisture retention in the soil and generally an increased crop production following application thepractice.
Application guidelines f orusers	Extension and training material available such as brochure
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO EMBU Vice Chancellor University of Nairobi Kabete CampusVice Chancellor, Egerton University
Lead organization andscientists	KALRO Embu – Catherine Muriithi and Dr Alfred Micheni Egerton University- Prof Paul Kimurto University of Nairobi –Prof Paul Kimani
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed ,NGOs, CBOs, County Governments, KEPHIS

TIMP name	**Mulching**
Category (i.e. technology, innovationor management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds infestation, soil moisture and loss of organic matter, inASAL.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials or synthetic materials to control weeds fromseeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or natural mulches including straw, dead leaves and compost to make
	more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used in growing for long season AIVs. Only black mulches should be used to control weeds.

	Benefits: Organic mulches suppress weeds while retaining moisture in the soil; keep the soil cool; improve soil fertility (as the mulches decompose) and improves microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weedseedlings and weed seeds.
Justification	Organic mulching has added benefits other than minimizing weeds infestation, it facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing rain drop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable and effective in weed control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used indissemination	• Farmer field schools • On-farm demonstrations during farmer field schools • Training in workshops
Critical/essential factors for successfulpromotion	• Organic: • Availability of plant or crop residues for organic mulches. • Size of the land. • Competing uses of crop residues. • Type of the cropsSynthetic • Cost of materials • Disposal of material after use.
Partners/stakeholders for scaling up	County government extension services; Provide link with
and their roles	Farmers Community farmer groups; play coordination role for ease inproblem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	Not used in beans in Kenya. Used in Thailand.
Current extent of reach	Available and practiced in different commodity value chains
Counties where TIMP will bepromoted	Where beans are a priority value chain. All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competinguses in organic mulches. • Possibilities of insect build up categorized as pest or diseasevectors or weed seeds in organic mulches.

Suggestions for addressing thechallenges	• Crop diversification to increase availability of organic mulches. • Establish and follow a good integrated pest control management program for the particular beans. • Adapting alternative mulching materials like high absorbance polymers in AIVs.
Lessons learned	There is need to adapt to alternative mulching technologies inaddition to use of organic materials like crop, plant residues.
Social, environmental, policy andmarket conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive during the initialapplication.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	Mulching work is mainly done by women who have any other roles creating more work for them Women might not be aware that mulching is used as a weed control Women have limited access to productive resources such as land so they might not have enough residues to do mulching The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	There is potential of reduced workload for women Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is labour intensive for VMGs, hence its adoption and scaling up is a challenge. VMGs have limited access and control of productive resources such as land The VMGs have no finances to pay hired labor due to limited access to credit facilities
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice Improves food production and nutrition for VMGs.
E: Case studies/profiles of success stories	

Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	User guidelines are dependent on value chain 1.Plant AIVs in clean seed bed 2 Apply mulch between the rows of AIVs. Mulch management Pull or kill weeds that grow out of the mulch near the AIV plant.
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requiresvalidation; 3=Requires further Research	Ready to use.
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira, Dr v Mumanyi
Partner organizations	County governments Public- Private-Partnerships

Research Gaps:
Determine cost benefits of using biodegradable biological and plastic mulch versus other IWM strategies in AIVs production

2.7.4 TIMP Name	**Chemical Weed Control**
Category (i.e. technology, innovation ormanagement practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Heavy weed infestation in AIVs fields
What is it? (TIMP description)	Chemical weed control refers a technique that involves the application of herbicide to control the growth of weeds or to soil to kill emerging weed seedlings and/ or weed seeds. Herbicide technology requires knowledge on herbicides required for specific crops, weeds occurring and the environmental conditions in the cropping system. Use ONLY Recommended herbicides where need be. .

Justification	Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and effects can be timely weed control.
Region promoted	Limited use of herbicide among small scalefarmers
Counties where TIMP will be upscaled	Herbicide weed control can be upscaled inall the areas where beans are being grown.
B: Assessment of disseAIVs mination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of chemicals
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successfulpromotion	Capacity building and training on safe useof chemicals for all users
Partners/stakeholders for scaling up andtheir respective roles	• Public and private partners –[MOALF&I)for extension, • Chemical companies for back stopping • ICRISAT for technical backstopping and promotion; • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro- finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale salesand marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Validation of these herbicides needs to be done before recommendations are given to the farmers.
Challenges in dissemination	Limited knowledge and information and low literacy levels among the farmers. Limited technical knowhow and knowledge on herbicide use and application which requires training for effective and safe use.
	The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing	There is need to train the agricultural extension county

thechallenges	officers as TOTs on safe use of herbicides. This help in reaching the farmers with the information. Herbicides like all chemicals have to be used with care to avoid environmental and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for guidance on safe use of chemicals
Lessons learned	Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.
Social, environmental, policy and marketconditions necessary	Sensitization of communities on alternative methods of weed control and safe use ofchemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Herbicide use is cheaper than manual weedcontrol because it requires less labour.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Women and children are the main sources of labour in in AIVs farms • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities. • Women and youth have limited access to productive resources such as credit to buy weed control chemicals • Women and youth have limited access to education, training and extension services and on new technologies such as weed control chemicals • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels on types of chemicals to use at the farm level • Women have limited access to information, technology and knowledge on stalk disposal as compared to men • Women have got limited access to funding as compared to men to purchase the weed chemicals • There is slow information and awareness flow to female farmers due to their low academic levels
Gender related opportunities	• . The technology would create employment for the youth and women within the potatoes value chain • Youth could form groups and engage in spraying weed using weed control chemicals • The adoption of the TIMP will lead to reduced work for women as it will attract men into engaging into weeding There will be increased yields and sales leading to improved food and nutrition security

VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit to access fertilizers and farmyard manures. • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	• Use of herbicides will improve weed management leading to increased productivity, increase availability of AIVs for consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
E: Case studies/profiles of success stories	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to containers on how to use.
F: **Status of TIMP Readiness (**1. Ready forup-scaling; 2. Requires validation; 3. Requires Research **)**	Requires validation and more research
G: Contacts	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr.Jedidah Maina, Charity W. Muchira.
Partner organizations	ICRISAT Nairobi; MoALF in Counties ,Chemical companies

Research Gaps:

Determine cost benefits of using chemicals versus other integrated weed management strategies inAIVs production

2.7.5 TIMP Name	**Mechanical weeding**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeding labour and timeliness in Weed management.
What is it? (TIMP description)	This is where an implement is used to weed after having planted clean certified seeds in weed free well prepared ground Planting should be done in rows to facilitate inter row weeding. Two weedings at 15 and 30 days after sowing (DAS)

	2) **Row Weeders (Manual/ motorized)** These implements are used to weed between the rows. The intra row weeds are removed by hand pulling.
Justification	Weeds if not controlled will cause yield lossesdue to competition. The weeds will also hosts insects pests and pathogens increasing cost of production. This Lowers quality of the produce and reduces productivity..
Region promoted	All areas where AIVs grown
Counties where TIMP will be upscaled	All counties growing AIVs
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation. Field days, Shows, Farmer to farmer communication, Leaflets, Larger plot demonstrations.
Most effective approach	On-farm experimentation and larger ploteffect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Jua Kali artisans • Processors and manufacturers to create market for produce, aggregators e.g. CARD(Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Limited research done on gender responsive weeding implements i.e row weeders are heavy and can only easily be handled by men
Challenges in dissemination	Implements not readily available in The market.
Recommendations for addressing the challenges	Work with Jua Kali industries for fabricationof appropriate implements.
Lessons learned	Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the available technologies and management practices in weed

	management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of the weeder (implement is high - 28,000 for ordinally bean farmers, they can purchase as a group.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• Mechanical weeding is labor intensive for all gender especially for women • Weeding increased labour for women who are already overburdened by their multiple gender roles • Women and youth have limited finances to pay labor services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in AIV farms • Women and youth have limited access and control of production resources such as land, credit to purchase farm equipment • There is need to equip women, youth and stakeholders with information relating to mechanical weed control method • There is also need to sensitize all genders on the losses caused by weeds and the importance of timely weed control.
Gender related opportunities	• Timely weeding will lead to increased potatoes production • There is a potential of creating employment for women and youth at various nodes of potatoes vale chain • Increased potatoes production will lead to increased household incomes and improved food security. • Mechanical weeding reduces labour for women as men are attracted to participate in weeding also
VMG issues and concerns in development , dissemination adoption and scaling up	• Mechanical weeding is not friendly for VMGs as it is labour intensive • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG related opportunities	• Increased production will improve food security and nutrition for VMGs

	• If adopted the VMGs will get employment at various nodes of AIVs value chains • There is potential for increased incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Not yet accessible to bean farmers.
Application guidelines for users	Production manuals to include weed management TIMPs
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requiresfurther research**)**	5) Ready for up-scaling 6) Rower weeder is heavy so not friendly to women users. Research on gender sensitive weeders.
G: Contacts	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr. JedidahMaina, Charity W. Muchira, Dr. Ruth Amata
Partner organizations	ICRISAT Nairobi; MoALF in Counties

Research Gaps:

Determine cost benefits of using mechanical weeding tools e.g motorized knap weeder versusother Integrated weed management strategies in AIVs production

2.7.6 TIMP Name	**Safe Use of Agrochemicals**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Excessive pesticides application to crops, use of pesticides for spraying crops without wearing the right protective clothing, storage of pesticides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use of pesticides without following the guidelines provided on the labels. Inadequate enforcement of global policies and regulation on use of pesticide all lead Environmental, health and social concerns and problems affecting many AIV producing regions.
What is it? (TIMP description)	This is a practice of Capacity building stakeholders, crop protec tion teams on safehandling, application, use of pesticides right from transportation from
	the agro-dealers to storage in a special store, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large and community sorrounding. The management practice will include proper methodologies for pesticide disposal to minimize pollution of the environment.

Justification	Although cases of improper use of pesticides are very common in most of the areas where AIVs is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users and stakeholders'to be made aware of the best practices that should be used for save handling of pesticides. There has been reports of increase of chronic diseases in human beings attributed to pesticide misuse and safe use capacity building can reduce social, environmental costs of diseases
B: Assessment of dissemination and scaling up/out apprisoaches	
Users of TIMP	Farmers, AIV Producers
Approaches used in dissemination	Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinic, Pesticides spray Demonstrations
Critical/essential factors for successful promotion	Collaboration between all partners, willingness of farmers to adhere to proper guidelines Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers farmer groups/CBOs to participate in the implementation of the variousAIVs training on weeds management, KALRO and Universities to develop the technologies and conduct ToTs. CABI, AAK, PCPB, KEPHIS participate as stakeholders.
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	Nakuru, Trans Nzoia, Kakamega, Bungoma, Machakos, Makueni, Nyeri, Laikipia
Counties where TIMPS will be up scaled	All regions suitable for growing AIVs
Challenges in dissemination	• Change of mindset in favour of current practices maybe difficult to achieve, • Illiteracy and inadequate capacity to use pesticides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of pesticides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose pesticides properly
Suggestions for addressing the challenges	• Capacity building and sensitization forums for both farmers and agro dealers using participatory approach • Formation of youth spray teams • Establishment of aggregation centres for pesticide containers • Establishment of training of Extension staff and lead farmersas TOT • Increase surveillance along the border points and enforce thelaws_
Lessons learned in	Upscaling of this technology needs young men and youth due toits

upscaling if any	hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collectionand incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.
Social, environmental, policy and market conditions necessary	Organized collective marketing channels and trainings are critical are for benefits tobe derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 60,000 per acre
Estimated returns	KES 500, 000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	• Technology is not safe for use by expectant women and the physically challenged individuals because of it hazardous/dangerous nature • Pesticides and protective gear are expensive and most women may not afford them • Lack of knowledge by men and women on the dangers of chemicals especially on storage and disposal • Low levels of illiteracy and inability to read and interpret the content of the herbsides labels especially on re-entry period after spraying and PHI. This cause herbecides poisoning to men and women who spray and harvest the AIVs
Gender related opportunities	• Formation of spray teams by men • There is reduced labour for women • Formation of spray teams by men and youths hence creating employment for the youth • The use of safe chemicals in weed management and control attracts men in weeding which traditionally used to be done by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• These are dangerous products that may not be handled by vulnerable groups • These are dangerous products that may not be handled by vulnerable groups. • Herbicides are expensive for VMGs to afford • VMGs have limited access to productive resources such as land, credit to access farm inputs such as herbicides • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals

VMG related opportunities	• Safe use of herbicide can easily be undertaken by the VMGs as employment where by they can form herbicide spray teams in the wards in each county and they charge for services provided • VMGs have the potential of operating agro-vets to stock farm inputs such as herbcides, pesticides, fertilizers among others • The use of weed control chemicals contributed to reduced labor burden for VMGs
E: Case studies/profiles of success stories	
Success stories	• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to pesticides • There are reported cases of farmers who regularly scout their crop that have reported to using less pesticides on their farm • Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction ofthese containers on farms • Safe use of Pesticide campaigns by AAK, PCPB KALROand MOLF&I have
Application guidelines for users	Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Develop techninician and youth spraying teams with pesticide decision guidelines, manuals, brochures developed by KALRO and other stakeholders as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling;
F: Contacts	
Contacts	Centre Director KALRO Kabete
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr Jedidah M. Maina and Charity W. Muchira. Dr. Ruth Amata
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

Research Gaps:

Management of troublesome perennial grass weeds and sedges in AIVs.

7.8 Mechanization of AIVs Production Activities

11.6.1 TIMP Name	**Power tiller**
Category (i.e. technology, innovation or management	Technology

practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIV commodity • Delayed operation lead to late planting • High cost of manual labour • Inconsistent land preparation
What is it? (TIMP description) Ploughing tractor 14HP  (source: KALRO-Katumani	A Power Tiller is a two-wheeled agricultural implement fitted with rotary tillers, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 1ha per day by one operator in about two hours. This will vary depending on the climatic conditions, soil types, soil moisture content, stamina and experience of the operator. Fuel consumption is about 15 liters per ha. Though these results varies with the technical ability of the operator.
Justification	It has multiple uses and other advantages. Power Tiller helps in preparing the soil, sowing seeds, planting seeds, spraying the fertilizers, herbicides and water. In addition to it also helps in pumping water, harvesting, weeding and transporting crops. A power Tiller is ideal where the land size is small. Farm sizes average less than one hectares which limit turning ability of conventional tractors while manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of the machines • High initial cost for small-scale farmers to import or when fabricated.
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if	Mechanization in agriculture increases production

any	
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Power tiller is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment due to lack of finances due to limited access to credit facilities • AIVs Power tiller should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Power tiller increases participation of household members in working in AIVs farms that is women, men and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating power tiller is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the equipment • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Power tillers need to be designed in such a way which would enable people abled differently to operate it • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals

F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, 0733812953
Partner organizations	Local Fabricators

11.6.15TIMP name	**Wheeled Tractor less than 50Hp**
Category (i.e. technology, innovation ,or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in the commercialized AIVs commodity • Drudgery and fatigue • Low output • Inefficiency and inconsistency of work. • Untimeliness • High cost of manual labour
What is it? (TIMP description) 	A tractor is an engineering vehicle specifically designed to deliver a high tractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) tillage, trailer towing, planting, weeding, ridging, planting, spraying, harvesting, ground grading and much more agricultural functions. Agricultural implements may be towed behind, mounted behind or in front of the tractor and the tractor may also provide a source of power if the implement is mechanized. It is therefore fitted with various equipment at alternate times for easing farm operations
Justification	A Tractors is an essential necessity of farming as it provides machine power for performing farm applications. In addition to routine farm activities, it is efficient, timely, consistent, releases labour and reduces cost as compared to manual labour. With a small horse power of 50, it is affordable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities

Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the tractors • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying a tractor • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	Organized producers' groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Tractor – KES 1,500,000 Plough – KES 350,000 Harrow – KES 400,000
Estimated returns	2ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• The wheeled Tractor less than 50Hp is can be used by all • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities such as Wheeled Tractor less than 50Hp • Men dominate most decisions at the household and community levels hence they make decisions relating to land preparation for AIVs and also on equipment to be used in the farms • AIVs farming machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • The is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	• Creates employment especially for women and youth

	• Reduces drudgery for women farmers as well as men • Promotes inclusivity of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating Wheeled Tractor less than 50Hp is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not know where to get such tractors • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to purchase the tractor since it is affordable and easy to maintain machines
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs • Promotes inclusivity of all genders
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Traders, Processors

11.6.16TIMP name	**Mould board plough**
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Unbroken heavy clods in the soil and gives it an uneven structure. • Uneven plough depth

	• Requirement of added weight for ballasting by disc plough.
What is it? (TIMP description)  Source; captain tractors pvt. Ltd	Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation. The plough conserves moisture and biomass while pulverizing the soil hence climate smart.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is Versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kakamega, Kirinyaga, Murang'a
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying the plough • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials

	• Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Plough – KES 380,000
Estimated returns	5 year working
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in their farms • Mouldboard plough can be used by all genders including women • Mould board plough AIVs equipment is expensive for women to purchase • AIVs farming machines should be designed for easy start and operation by all gender. • There is need to equip women, youth and stakeholders with information relating to the Mould board plough • Linking the women and youth to financial institutions would enable them to buy since it is affordable and easy to maintain machines
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating mouldboard plough is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence might not be aware of mould board plough • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMGs
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology can be easily utilized by all gender categories (especially women and youth)
Gender related opportunities	• It offers good opportunity for commercial venture that can empower all gender categories

VMG issues and concerns in development, dissemination, adoption and scaling up	The technology can be easily utilized by all VMGs
VMG related opportunities	Offers opportunities for lucrative commercial venture by VMGs
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.17TIMP name	**Disc Harrow**
Category (i.e. Technology, Innovation or Management Practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Slow and tedious processes of seedbed preparation, in a commercialized AIVs commodity • Difficult to break clods manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)  Source; https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.sv	A harrow, farm implement used to pulverize soil, break up crop residues, uproot weeds and cover seed. It is a farm implement used for surface tillage. It is used after ploughing for breaking up and smoothing out the surface of the soil. The purpose of harrowing is to break up clods and to provide a smooth soil structure, called tilth, that is suitable for planting seeds. Coarser harrowing may also be used to remove weeds and to cover seed after sowing.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is versatile. The

	various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Value chain actors' trainings, demonstrations, Farmer Field, Schools, ASK Shows, trade fairs, Pamphlets, publications etc.
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service for technology dissemination, individual Farmers, farmer groups/CBOs,
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga, Tharaka Nithi, Meru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Garissa, Mandera, Siaya, West Pokot
Challenges in dissemination	• High initial cost for small-scale farmers • Lack of the mould board ploughs • Fear of machines
Suggestions for addressing the challenges	• Produce profitably to generate money for buying the harrow • Acquaintance with machines through training • Encourage group investment
Lessons learned in up-scaling if any	• Low level of extension • Increase farmer machine interaction • Conduct demonstrations
Social, environmental, policy and market conditions necessary for upscaling	• Organized producer groups to ensure consistence availability of raw materials • Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Harrow – KES 350,000
Estimated returns	3 year working
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Disk Harrow can be used by all genders but it is expensive to purchase by stakeholders especially by women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels hence determines the type of equipment to be used in AIV farms

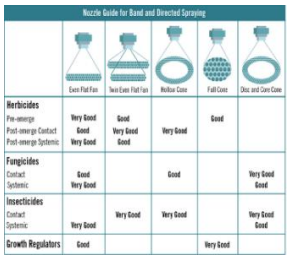
	• AIVs cultivation is associated with women although some productive resources are owned by men such as farm equipment this being the men might not purchase the disk harrow since they have no interest in AIVs • There is need to equip women, youth and stakeholders with information relating to the AIVs disk harrow
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating a disk harrow is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not be aware of the existence of a disk harrow and how it is operated • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Farm machines need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordability and easy to maintain machines for all types of farmers
VMGs opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMG farmers
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Kirinyaga at household level but needs to be up scaled contractual level
Application guidelines for users	Brochures and factsheets with detailed guidelines on AIVs value addition documented
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.18TIMP Name	**AIV Planter**
Category (i.e. technology, innovation or management	Innovations

practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of planting, in the commercialized AIV commodity. High seedling density hence need for labour in thinning. High cost of Manual labour .
What is it? (TIMP description) 	A seed drill is a farm implement that sow seeds at a desired seeding rate and depth, ensuring that the seeds are covered and compacted under soil. This saves them from being eaten by birds and animals, or being dried up due to exposure to sun. With seed drill machines, seeds are distributed in rows, however the distance between seeds along the row can be adjusted by the user. This allows plants to get sufficient sunlight, nutrients, and water from the soil. A Seed Drill is designed to provide the flexibility to configure the planter to suit your requirements. Features including powder coated large capacity seed and fertilizer boxes which can sow a large range of seeds and fertilizers from both boxes. The seeding/fertilizer rate can be infinitely varied simply by moving a lever. The boxes also have a clean out plate for easy clean out.
Justification	To make AIVs production activities less tedious and more effective. Attract the youth to agribusiness through operation of the machines. Before the introduction of the seed drill, most seeds were planted by hand broadcasting, an imprecise and wasteful process with a poor distribution of seeds and low productivity. Use of a seed drill can improve the ratio of crop yield (seeds harvested per seed planted) by as much as nine times Sikander et al., 2003.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up and their roles	KALRO, universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • Lack of capacity for small-scale farmers to purchase
Suggestions for addressing the challenges	• Fabrication of affordable AIV production machines
Lessons learned in up scaling if any	• Mechanization in agriculture increases production through efficient operations

	• Timely planting
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	485,000.00
Estimated returns	5ha/hr
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIV planter is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment as they lack finances due to limited access to credit facilities • Women have limited access to agricultural information and extension services hence they might not be aware of the existence of the AIV planter • AIV planter should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits • Men make decisions relating to what machines should be used in their farms since they control all the productive resources
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • AIVs planter increases participation of household members in working in AIVs farms that is women, men and youth • Adoption of AIV planter reduces loses incurred due to poor planting of AIVs reading to some being eaten by birds and others being burnet by the sun
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating AIV planter might be complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the AIV planter • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • AIV planters need to be designed in such a way which would enable people abled differently to operate • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs

	• Reduces losses incurred during planting of AIVs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as AIVs, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires	Requires further research
further research**)**	
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.19TIMP Name	**Motorized Sprayer**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of planting, in the commercialized AIVs commodity • High seedling density hence need for labour in thinning
What is it? (TIMP description)   Nozzle Guide for Band and Directed Spraying Even Flat Fan / Twin Even Flat Fan / Hollow Cone / Full Cone / Disc and Core Cone Herbicides — Pre-emerge: Very Good / Good / Very Good; Post-emerge Contact: Good / Very Good / Good; Post-emerge Systemic: Very Good / Very Good / Good; Good Fungicides — Contact: Good / Very Good; Systemic: Good; Very Good / Good Insecticides — Contact: Very Good; Systemic: Very Good / Very Good; Very Good / Good Growth Regulators: Good; Very Good (Source; Nasirembe, Katumani, 2021)	A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides and fertilizers on agricultural crops Sprayers are man-portable units typically backpacks with spray guns They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron e.g. as well as foliar fertilizers.
What is it? (TIMP description)	Pest reduce yields up to 98% and are a major menace in agricultural production. Before AIVs forms a canopy, broad leafed weeds compete with Cabbage seedling for nutrients and light greatly reducing their yield. A manual sprayer is labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency

Justification	To make AIV production activities less tedious and more effective. Attract the youth to agribusiness through operation of the machines. With a motorized knapsack, a farmer is able to spray 4 times more in a day compared to the manual one. The farmer can also use the sprayer to spray livestock to control pests
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Lack of the machines • High cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	Local fabrication of affordable AIV production machines
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer – KES 56,000
Estimated returns	0.5ha /hour
Gender issues and concerns in development, dissemination, adoption and scaling up	• Motorized sprayer is designed for easy start and operation . • Women and youth have limited finances to pay services and to purchase farm equipment such AIVs motorised sprayer due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization hence might not be aware of the existence of motorised sprayer • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • With the introduction of motorised sprayer men have been drawn weeding in AIVs farms, weeding was predominantly done by women before the introduction of the machine.
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men

	• It promote gender inclusivity reducing the work load for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Operating a motorized sprayer is complex for some VMGs especially those who are abled differently • AIVs machines need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• Creates employment for VMGs • Reduces drudgery for VMGs farmers • It promote productivity hence providing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as Maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.20TIMP Name	**Power weeder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIV • Quality of leaf
What is it? (TIMP description)	Power weeder is a device used for removing the weeds, stirring and pulverizing the soil and for loosening the soil after the crop has begun to grow. It is a self-propelled power weeder with a fully functional gear box having one forward and reverse gear transmission with clutch. It is suited for small and large scale AIVs farmers

 (Source: Shakti Industries)	
	weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make AIV weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. Hand weeding is tedious and time consuming while manual operations are timewasting and expensive.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Good collaboration between all partners • Adequate facilitation: Funds, Logistics (Transport) • Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.

	• Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIV knapsack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs power weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs power weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs power weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the TIMP • AIVs power weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs power weeder due to limited access to credit facilities • Operating a AIVs power weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP • AIVs power weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani;

	P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors

11.6.21TIMP Name	**Back Pack Weeder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of Manual weeding and winnowing of AIVs • Quality of leaf
What is it? (TIMP description) 	It is a hand held machine that simultaneously cut the soil and weeds in AIV and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make AIVs weeding faster, less tedious and more cost effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya

Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local Industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs Back Pack weeder 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up	• AIVs back pack weeder is not affordable to purchase especially by women and youth as they do not have funds • Women and youth have do not have finances to hire services of AIVs back pack weeder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating hence they might not be aware of AIVs back pack weeder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • The is need to equip women, youth and stakeholders with information relating to the AIV back pack weeder • AIVs back pack weeder should be easy to operate for all genders and affordable
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts men participation in weeding
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase AIVs back pack weeder due to limited access to credit facilities • Operating a AIVs back pack weeder is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to the TIMP

	• AIVs back pack weeder need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable and easy to maintain machines for all types of farmers
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIV contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953

TIMP Name	**Back AIVs Harvester**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of Manual weeding and winnowing of AIV Quality of leaf
What is it? (TIMP description)  (Source:https://www.alibaba.com/product-detail/Convolvulus-harvester-spinach-harvester-and-Leaf_1600070046703.html?spm=a2700.7724857.0.0.141c1e66be7uVP)	It is a hand held machine that simultaneously cut the vegetable leaves and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to harvest specified spacing inter raw within AIVs as; Amaranthus, African night shade, cow pea, spider plant, etc. It runs on electricity not to contaminate the crop. Electric motor drive, no pollution, low labour intensity. Has a wide and flat cutting table, Independent unit control for cutting and walking conveyer, easy to operate; With High efficiency, cutting, transportation, collection in one machine and can harvest multiple vegetables, for example:
Justification	To make AIVs weeding faster, less tedious and more cost

	effective. Attract the youth to agribusiness through operation of the machines. It reduces drudgery and releases family labour for other chores greatly increasing total productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIVs Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, ASK shows and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AIVs harvester KES 597,600 per unit
Estimated returns	• Capacity 0.25ha/ hour, 0.003kW /hr Harvesting charges: KES 1,600 per hectare
Gender issues and concerns in development and dissemination	• Back AIVs harvester can be used by all genders but it is expensive for AIVs to afford especially women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm equipment such as back AIVs harvester • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in harvesting AIVs • Back AIVs harvester should be designed for easy start and operation.

	• There is need of up-scaling back AIVs harvesters and all the genders should be targeted
Gender related opportunities	• Reduced labour intensity in harvesting • High productivity is increased leading to increased food security and nutrition • Creates employment especially for women and youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as Back AIVs harvesters due to limited access to credit facilities • Operating a Back AIVs harvester is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the Back AIVs harvester • Linking the VMG to financial institutions would enable them to buy Back AIVs harvester since it is affordable and easy to maintain machines • Back AIVs harvesters need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• Reduced labour intensity in harvesting for VMGs • High productivity which leads to increased food security and nutrition • Creates employment for VMGs • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for AIVs contracted farmers
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Require validation
S validation	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Sam Nyakach-0733812953
Partner organizations	JKUAT, MOA, Tractor hire service contractors
Partner organizations	JKUAT, MOA, Tractor hire service contractors

7.9 Slender Leaf Postharvest Handling

TIMP Name	Slender leaf sorting and grading
Category (i.e. technology, innovation or management practice	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inferior quality and low prices from unsorted vegetables
What is it? (TIMP description)	• Slender leaf vegetables are sorted to remove infected vegetables, yellowing spotted vegetables, weeds and debris. • Grading vegetables according to leaf size, weight, maturity, turgidity, physical damage, and market demand 
Justification	Sorting ensures that quality vegetables reach the market and prevent cross contamination between infected and good vegetables. Vegetables of superior quality fetch higher prices in the market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increasing awareness on the benefits of sorting and grading among value chain actors, postharvest trainers, well-organised farmer groups
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling and value addition of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on vegetable postharvest handling • Green grocers and vegetable sellers • Supermarkets and institutions (e.g. schools and hospitals) - will provide markets for vegetables
C: Current situation and future scaling up	
Counties where already promoted if any	Vihiga, Busia, Kakamega

Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of premium price for quality vegetables discourages farmers and traders to adopt the practice
Suggestions for addressing the challenges	Avail market which offers better price to higher quality vegetables.
Lessons learned in up scaling if any	Create awareness on important of sorting and grading the vegetables
Social, environmental, policy and market conditions necessary for development and up scaling	• Create market that pay premium price to sorted and graded high quality produce. • Producers and traders will adopt the practice • Framers and producers are willing to adopt the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost
Estimated returns	Sorting and grading translates to high quality, which fetches higher income.
Gender issues and concerns in development dissemination, adoption and upscaling	• Sorting and grading of slender leaf is usually done by women increasing their labor. It is easily adoptable after training and many farmers can use the technology since it reduces losses incurred after harvesting and increases income. • Women have less access to information on slender leaf packaging • Women and do most of the work within the slender leaf value chain but the funds are controlled by men hence they have no funds to pay the workers • The management practice are easily applicable hence farmers can easily learn them.
Gender related opportunities	• There is reduced slender leaf post- harvest losses • Creates employment for women and the youth • Increases income for women and the youth • There is increased food security and nutrition for household
VMG issues and concerns in development, dissemination, adoption and upscaling	• Sorting and grading of slender leaf is labor intensive for some VMGs to undertake • VMGs have limited finances to pay labor services due to limited access to credit facilities • VMGs have limited access to agricultural information and extension services hence they might not be aware of the importance of sorting and grading
VMG related opportunities	• The technology will create jobs hence source of income for VMGs • The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • There improved food security and nutrition for VMGs

	• VMG have limited access to training and education on the fruit packaging
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Indigenous vegetables collection centres in Busia county
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:
None

2.8.1 TIMP Name	**Zero Energy Brick Cooler**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses (30%) caused by lack of cooling technologies for vegetables
What is it? (TIMP description)	The Zero Energy Brick Cooler consist of a double brick wall filled with sand in between, and a storage chamber. The sand is kept moist with water. The inside chamber is cooled through of the water in the sand.

	
Justification	Appropriate cooling reduces postharvest losses and extends shelf-life
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, green grocers, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The sand should be continuously moist. Cooling is more effective in dry and windy environment
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowledge on ZECC
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Kirinyaga
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	Lack of starter capital to construct the cooler as individual farmer
Suggestions for addressing the challenges	Organize farmers into groups to enable them construct a cooling unit
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the ZECC
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware ZECC slender leaf storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits

	• Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for slender leaf storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the ZECC
Gender related opportunities	• There will be increased shelf life of slender leaf • There will be increased employment opportunities for the youth and women at various nodes of slender leaf value chain • There will be stable supply of slender leaf for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of slender leaf • There will be stable supplies of slender leaf for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. have used the technology to reduce losses and extend shelf-life, hence the marketing time for the vegetables.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

- Optimizing the storage conditions and keeping quality of the different vegetables.
- Validate the technology in difference AEZs.
- Research on innovative investment options for farmers and groups.

2.8.1 TIMP Name	**CoolBot™**
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of appropriate cooling technologies for vegetables
What is it? (TIMP description) 	It is a low cost postharvest temperature management that improved the shelf life of banana using less power The Coolbot™ is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lesser cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as 4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.
Justification	CoolBot provides inexpensive, effective cooling. Appropriate cooling reduces postharvest losses and extends shelf-life for consumption and marketing. Farmers who can store their produce longer can take advantage of better prices, as market prices can fluctuate dramatically over time.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension workers, women and youth groups, aggregators, traders, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Increase postharvest training and direct farmer outreach
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot™ Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooing vegetables. • Limited awareness of the technology by farmers • Inadequate funds to install the Coolbot™

Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases tp adopt the CoolBot™
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• CoolBot (US$ 300) • Air conditioner • Insulated room • Monthly electricity costs
Estimated returns	• Increased income. Farmers can store vegetables to sell in the off-season when prices are higher. • Improved cold storage facilities will stabilize fruit and vegetable prices, giving consumers access to nutritious fresh produce all year. • Farmers are better protected to erratic market prices.
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware CoolBotTM pumpkin storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for pumpkin storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the CoolBot™
Gender related opportunities	• There will be increased shelf life of slender leaf • There will be increased employment opportunities for the youth and women at various nodes of slender leaf value chain

	• There will be stable supply of slender leaf for markets and food
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of pumpkin • There will be stable supplies of pumpkin for the markets and for food for VMGs • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories	- Fruit and vegetable farmers in Embu, Kirinyaga, etc. - **Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre** to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guideline for users	CoolBot™ factsheets, brochures and manuals available from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Gaps:

- Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the CoolBot™.
- Gross margins of the Coolbot™

2.8.1 TIMP Name	Wakati™ technology
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of cooling technologies for vegetables
What is it? (TIMP description) 	-Wakati™ is a simple and innovative solution where altered environment in the chamber contributes to shelf life extension -Altered environment is due to: - High relative humidity - Oxidation of ethylene from the storage environment by oxidizing (ozone oxidation) It is a 1m by 1m canvas tent with a solar powered fan to one corner. The fan is placed in a cuplike reservoir. As it rotates, it picks up water into mist droplets, which are distributed in the tent by air currents. When a moisture concentration of 80% is achieved, the surface of the fruit or vegetables remain fresh because there is no loss of water. This low-cost solution helps produce last up to 10 times longer without any refrigeration.
Justification	Appropriate cooling reduces postharvest losses. The technology increases shelf life and can be stored without refrigeration, gives farmers more time to sell. The climate control approach used by Wakati™ is affordable and clean technology.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh vegetables (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	The optimal use of Wakati One is outside, in a warm and dry climate. Apart from a small amount of water— around 1L of water a week—it does not require any extra resources. The product does not need a power grid, it works on solar energy.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling vegetables. • Limited awareness of the technology by farmers • Inadequate funds to install the Wakati™

Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases tp adopt the CoolBot™
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	• Women and youth might not be aware Wakati™ technology pumpkin storage due to limited access to agricultural information and technology • The TIMP is expensive for women and youth to afford as they do not have finances due to limited accesses to credits • Men dominate most decisions at the household and community levels hence determines the type of facilities to be constructed and to be purchased for slender leaf storage • Women have no access and control of productive resources such as land, farm equipment and credit so women might not have land and resources needed for establishing the Wakati™ technology
Gender related opportunities	• There will be increased shelf life of slender leaf • There will be increased employment opportunities for the youth and women at various nodes of slender leaf value chain • There will be stable supply of slender leaf for markets and food in families
VMG issues and concerns in development, dissemination, adoption and upscaling	• VMGs have limited finances to due to lack of access to credit facilities hence they might not be able to adopt Wakati™ technology • Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. So they might not be aware of the Wakati™ technology
VMG related opportunities	• The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercialization of pumpkin • There will be stable supplies of pumpkin for the markets and for food for VMGs

	• Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough AIVs to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

GAPS:

- Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the Wakati™.
- Gross margins of the Wakati™.

Modified Atmosphere Packaging of Slender Leaf Vegetables

2.8.1 TIMP Name	**Modified Atmosphere Packaging of AIVs** (Ziploc® and Xtend® bag packaging)
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses Limited knowledge on appropriate packaging of AIVs
What is it? (TIMP description)	Xtend® bags are modified atmosphere bags characterized by high moisture vapor transmission rates. This assures that excess moisture is eliminated, in the event that condensation forms within the bag. The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of AIVs for between 5-7 days

Justification	The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of AIVs for between 5-7 days.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh vegetables (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the vegetables • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits • Limited awareness of the technology by farmers and traders •
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of value chain actors on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases tp adopt the CoolBot™
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development, dissemination adoption and scaling up	• In the target counties, AIVs cultivation is mainly done by women who have limited access to agricultural information and extension services so they might not be aware of the Xtend® bags • Women lose their AIVs due to their limited shelf life and inefficient storage methods and limited knowledge of the new technologies Women have no finances to pay for Xtend® bags due to limited access to credits

	• The TIMP is easily adoptable after training, providing appropriate credit facilities and availing the Xtend® bags to local agro-dealers; many farmers can use the technology since it reduces losses incurred during storage
Gender related opportunities	• Opportunities for youth in selling Xtend® bags to farmers and traders • The TIMP increases farm income through reduction of postharvest losses and enhancing food safety, hence increased food security and nutrition for households.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs lacks access to information on new technologies and information so they might not be aware of the Xtend® bags • VMGs have no finances due to limited access to credit facilities to purchase the Xtend® bags • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the Xtend® bags means reduced postharvest losses and enhanced food safety for VMGs • The TIMP has the potential of prolonging shelf life of AIVs leading to improving food and nutrition security and a window for increased income. For VMGs • Opportunity for VMGs to engage in marketing of Xtend® bags
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guideline for users	Factsheets, brochures and manuals on Postharvest handling of AIVs from KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Kakamega Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

7.10 Slender Leaf Value Addition

2.8.1 TIMP Name	Solar drying of Slender leaf vegetables
Category (i.e. technology, innovation or management practice	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Short shelf life
What is it? (TIMP description)	The technology involves removal of excess moisture from slender leaf vegetables. This is done by use of Dehytray, green house dryer or cabinet solar drier 
Justification	Slender leaf vegetables have short shelf life leading to postharvest losses. Drying enhances the shelf life and reduces bulkiness during transportation. Dried vegetables are easily transported
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, consumers, women and youth groups
Approaches used in dissemination	Practical demonstrations, field days
Critical/essential factors for successful promotion	• Local artisans can be trained on fabrication, repair and maintenance • Ensuring sanitary condition when handling vegetables for drying
Partners/stakeholders for scaling up and their roles	Famers- to adopt the technology for usage Artisans - to fabricate the solar dryers Agricultural extension workers- to provide farmers with knowhow on solar drying of vegetables, and utilization of solar dried vegetables
C: Current situation and future scaling up	
Counties where already promoted if any	Isiolo, Kakamega
Counties where TIMP will be up scaled	Kakamega, Nyamira
Challenges in dissemination	• Limited knowledge on utilization of dried vegetables • Lack of funds to acquire the solar dryers • Challenges in repair and maintenance
Suggestions for addressing the challenges	• Sensitization of the community about high health and nutrition benefits of solar dried vegetables • Provide loans / capital to farmers groups to acquire the solar dryers • Capacity building of local artisans on repair and maintenance

Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Solar dried vegetables can be used in the dry season
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cabinet solar drier costs approximately KES 20,000/-
Estimated returns	Increased income, nutrition Reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	• Slender leaf cultivation is mainly done by women who have limited access to agricultural information and extension services so they might not be aware of slender leaf solar dryer • Women lack finances due to limited credit facilities so they might not be able to purchase pumpkin solar dryer • Most decisions relating to purchasing of farm equipment are made by men who have no interest in slender leaf value chain hence they might not purchase the dryer
Gender related opportunities	• The TIMP increases farm income through reduction of postharvest losses • Adoption of slender leaf solar dryer enhances food security and nutrition for households
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs lacks access to information on new technologies and information so they might not be aware of pumpkin solar dryer • VMGs have no finances due to limited access to credit facilities to purchase pumpkin solar dryer • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the pumpkin solar dryer means reduced postharvest losses and enhanced food safety for VMGs • The TIMP has the potential of prolonging shelf life of slender leaf leading to improving food and nutrition security and a window for increased income for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guideline for users	Solar drying guidelines and brochures from KALRO

F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation.
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100. Machakos Email: director.nri@kalro.org Phone: 0710629683
Lead organization and scientists	KALRO Francis Wayua, Christine Ndinya-Omboko
Partner organizations	KEBS, MoALF

Research Gaps
Limited information on success stories of AIVs.
Cultural issues in participation in some AIVs species value chains
Low information on profitability of AIVs in the project areas

7.11 Farming Business and Marketing of African Night Shade, Amaranth, Spider Plant, Slender Leaf, Cowpea, Jute Mallow and Pumpkine

TIMP Name	**Transformative Model of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Most of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers have small production units with limited use of improved inputs. This leads to low African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine productivity. Low productivity leads to poor market access, .
What is it? (TIMP description)	An approach to transform smallholder farmers from low improved inputs to high and therefore build market linkages. At the fully commercial level, inputs are accessed from the markets and outputs solely for the markets.
Justification	Market failures or missing markets of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine have led to disorganization in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Due to the disorganization in production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, smallholder farmers fail to

	access markets or have limited market linkages. Therefore, this model aims at linking farmers to markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, Universities, policy makers
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of traders and other upstream actors • Acceptance of smallholder farmers to form production organizations • Investments in the production of quality tradable volumes • Acceptance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties by consumers • Adaptability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties • Prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Availability of storage infrastructure and transport
Partners/stakeholders for scaling up and their roles	• Farmers – Formation of production groups, investments in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local traders and exporters) – Support in input services and providing markets for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties

	• Group dynamics • Lack of seeds • Weak or non-existent stakeholder innovation platforms • Fluctuations in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices • Levels of production constraints • Level of policy support • Poor and week linkage
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production farmer groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming. Improved productivity • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine varieties – Use of promotion channels for instance meetings, stakeholder forums, media, demonstrations and field days • Group dynamics – Capacity building of the groups on group dynamics and management • Limited supply of demanded seed varieties – Engagement seed companies. • Capacity building of farmers on seed production • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Low and fluctuating African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine prices - Value addition, organized marketing channels, producer organizations, capacity building on the reduction of production costs, capacity building on farming as a business • Levels of production constraints – improving credit accessibility, enhancing adoption of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine TIMPs • Level of policy support – Lobbying for the County government support in policy formulations
Lessons learned in up scaling if any	• There is need to have an all inclusive enhance value addition in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to increase profits

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability by the farmers, group dynamics, cultures to have value added products • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), • infrastructure, investment environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Different acceptance characteristics by youth, females and males. Gender roles in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. Availability of technologies for pre-harvesting, harvesting and post-harvesting • Adoption and scaling – Different acceptance characteristics, Gender inclusion in the formation of producer organizations.
Gender related opportunities	• Production opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Emerging mechanization in the value chain • Generation of income by youth female and male
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited involvement of VMGs in the market linking models • Adoption and scaling up - Limited access to seed and information on production techniques
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generation using farmer-market linking arrangements • Access to inputs and markets through linkages and producer organization
E: Case studies/profiles of success stories	
Success stories from previous similar projects	High yielding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine hybrid seed bought by the county government of Marsabit and other counties
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires	Requires validation

validation, 3. Requires further research)	
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Evaluating efficiency of the farmer-market linking and business models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Building a Business Plan for African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Unplanned and traditional production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine leads to lack of production targets, losses and market failure, leading to low productivity.
What is it? (TIMP description)	A business plan is a document guides the operations in a business. The document contains details susch as introduction, business organization, product, marketing strategy, risks, business operation plan, marketing costs, Income streams, profit and loss analysis and financial requirements
Justification	A Business without a plan cannot identify its strenths, weaknesses, opportunities and threats. Guided by a business plan, farmers will not analyse opportunities, explore options, select the best option, detailed planning and implementation. There are many opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, processing and marketing.

	However, the achievement of the best opportunity would depend on the analysis of strength, weaknesses and threats.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, NGOs, Extension agents, policy makers and implementers
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Education levels of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farmers and other actors • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Supporting policies and regulations
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding opportunities • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders, processors and exporters) – Demanding opportunities • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production groups • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming

	• Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub • Levels of strengths, weaknesses and Threats in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Sensitization of stakeholders the challenges • Level of policy support – support in extension services
Lessons learned in up scaling if any	Need to address the challenges in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production to enhance benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming in the climate change situations • Environmental conditions – Use of opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Marketing opportunities for youth, men and females • Adoption and scaling – Harmonizing opportunities
Gender related opportunities	Production and marketing opportunities by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Limited opportunities • Adoption and scaling up – Comparisons of opportunities and weaknesses at the level of VMGs
VMG related opportunities	• Production opportunities – Available machines for labour reduction for the VMGs • Income generating opportunities for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Utilization of Amaranth in Kitui, Machakos and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires	Requires validation

validation, 3. Requires further research)	
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the SWOT matrix
- Efficiency in identifying the opportunities
- Performance of the opportunities

TIMP Name	**Profitability analysis**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The problem of failure of profitability analysis is common among the smallholder farmers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. This leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise in terms of low productivity and income
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain, leading to low productivity
Justification	Profitability analysis reviews the management success and sustainability of the Finger millet business. It indicates areas of adjustment .
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, policy makers
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	• Production programme • Availability of data on quantities of inputs requirements, costs, outputs and value
Partners/stakeholders for scaling up and their roles	• Farmers – Defining production programme • County extension staff - Capacity building

	• NGOs – Capacity building • Research – Cost-benefit analysis
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and Marketing • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production – Developing information hub • Defining production programmes of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Level of policy support – support in extension services
Lessons learned in up scaling if any	Majority of farmers do not keep records
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Environmental conditions – Opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Poor record keeping, low income, low engagement in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Adoption and scaling – Involvement of youth, females and males
Gender related opportunities	Implementation of production and marketing opportunities in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – African night shade, • Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production Programmes for VMGs • Adoption and scaling up – Levels of profitability
VMG related opportunities	• Production opportunities – African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production programmes • Profitable opportunities like production, processing
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Software for running the budgets
- Profitable opportunities
- Effects of record keeping

TIMP Name	**Marketing Innovation model for the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine Production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	As farmers produce and market African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, they fail to follow business principles including marketing strategies in farm operations and farm activities geared toward making a profit
What is it? (TIMP description)	Production and marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit. An entrepreneur farmer undertakes innovations and finances business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of finger millet, the market outlook will be narrow. Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles in farming leads to unsuccessful.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers., traders
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	• Organization of farmers • Availability of innovations • Achievement of profit • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	• Farmers – Acceptability of innovations • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders, processors, and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	

Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Small-scale farming • Availability of information • Profitability in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine farming • Levels of policy support
Suggestions for addressing the challenges	• Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional methods • Environmental conditions – Use of pesticides and disposal • Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the innovations adoption • Adoption and scaling – Differentiated innovations for instance spraying by females is difficult. Youth is normally engaged
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the innovations adoption • Adoption and scaling up – Capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs leading to improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments

Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Efficacy and suitability of various chemicals
- Sustainability based on market prices
- Innovations for the increased productivity

TIMP Name	**Collective marketing**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Low productive leading to lack of bargaining power and volumes for sale
What is it? (TIMP description)	A marketing or producer organizations formed by farmers
Justification	Poor farmers in many remote areas do not understand how the market works or why prices fluctuate; they have little or no information on market conditions, prices and quality of goods; they are not organized collectively; and they have no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market. Difficult market access restricts opportunities for income generation. Farmer organization provides relevant data to help solve marketing challenges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Barazas, Trainings, Factsheets, Manuals, Field days, ICT, Radio.

Critical/essential factors for successful promotion	• Organization of farmers • Availability of facilitators • Availability of many traders • Production volume and quality • Trust • Innovativeness
Partners/stakeholders for scaling up and their roles	• Farmers – Organization of groups • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators • County government – Policy support
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Availability of information • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organization • Small-scale farming – allocation of more land to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and aggregation of production to assume large scale-farming, improved productivity • Availability of information – Capacity building of producer groups • Policy support – Engagement with the county government
Lessons learned in up scaling if any	Reduction of transaction costs leading to increased profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented • Environmental conditions – Depleted soil nutrients due over-use of cultivated land and pollution due to use of pesticides • Policy conditions – Available policy support
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, men and females in the marketing organization committee • Adoption and scaling – Inclusion of youth, males and females in capacity building
Gender related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by youth, females and males in the production of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the formation of marketing organization • Adoption and scaling up – Consideration of VMGs during capacity building
VMG related opportunities	Increased production and sales of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of marketing organization
- Sustainability of the management of the organization
- Equity distribution in sales and income

TIMP Name	**Contracted production**

Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Markets failure in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves private companies extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.
Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension, research institutions, farmer cooperative societies
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Production volume

	• Enforcement and bidding contract farming
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff - Capacity building, signing contract • NGOs – Capacity building • Private sector (local traders and exporters) – Contract party and beneficiaries • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Lack of information by part of the producers • Level of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – Increase volume through increase in productivity • Lack of information by part of the producers – Capacity building • Level of policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	• Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming • Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management • Policy conditions– Policy in formulation and enforcement • Market conditions – volume, place, price, promotion, traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400

Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in signing of the contract • Adoption and scaling – Equity distribution of income based on contract farming
Gender related opportunities	Market access, increased income, improved livelihood
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building • VMGs • Adoption and scaling up – Participation in signing contract farming
VMG related opportunities	Market access, increased income, improved livelihood
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of contracted farming in terms of productivity, sales and profit
- Equity distribution
- Improvement in skill and information delivery

TIMP Name	**Digital marketing**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	

Problem addressed	Poor market access due to constraints in marketing channels, skills and market information leading to low productivity
What is it? (TIMP description)	Internet marketing refers to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and profitability analysis • Levels of experiences in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • Availability of information on African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of african night shade, amaranth, spider plant, slender leaf, cowpea, jute mallow and pumpkine • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira

Challenges in development and dissemination -	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	• Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – low levels of adoption of information technology • Environmental conditions– improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Capacity building in digital skills for the youth, men and females • Adoption and scaling – Capacity building on benefits of digital marketing skills for the youth, men and females
Gender related opportunities	Improved accessibility of information duel to availability of mobile phones by youth, males and females

VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Capacity building on digital skills • Adoption and scaling up – Capacity building on benefits of digital marketing skills for the VMGs
VMG related opportunities	Improved accessibility of information duel to availability of mobile phones by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Levels of digital skills by farmers
- Performance of the internet marketing in terms of productivity, sales and profitability

TIMP Name	**Market research**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Farmers' lack of market information on outlets and prices of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
What is it? (TIMP description)	A approach by farmers to gather market information
Justification	The rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market

	intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore participatory market research will assist farmer to gain knowledge on the structure and performance of markets leading to higher profit.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media, ICT
Critical/essential factors for successful promotion	• Availability of County policies • Willingness of farmers • Availability of targeted markets • Access to markets
Partners/stakeholders for scaling up and their roles	• Farmers – participants in market research • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine -byproducts market outlets. • Lack of skills in the use of communication technologies • Group dynamics • Policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Organization of producer groups for cooperate marketing. • Small-scale farming – Increase hectarage under African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, improving productivity and aggregation of produce to achieve large volume for the market • Inadequate information to stakeholders on the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production and marketing – Capacity building on sources of information.

	• Group dynamics – Capacity building • Policy support – Support in extension services
Lessons learned in up scaling if any	Improved marketing strategies
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Level of education of the community • Environmental conditions – Farmers are in different geographical localities • Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – Existing demand
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Involvement of youth, males and females in the participatory market research • Adoption and scaling – Capacity building youth, males and females
Gender related opportunities	Increased production and marketing opportunities by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Involvement of VMGs in the participatory market research • Adoption and scaling up – Capacity build VMGs
VMG related opportunities	Increased production and marketing opportunities for the VMGs leading to higher income
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Barazas, training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M.

Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Performance of participatory market research process
- Production and marketing efficiency in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine due to the participatory market research process
- Equity distribution in income and change in livelihood

7.12 Agricultural Policy Options

TIMP Name	**Advocacy in farmers' participation in the National Agricultural Policy development and implementation**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provide objectives
What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provides objectives.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter,email), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine-based policies
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers

	• Private sector (local traders and exporters) – Demanding African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Value Chain: African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • Standards: Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, wherein many farmers abandoned African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. These weak organizations provide few services to farmers while providing limited bargaining power. • Financial Incentives: The government provides only limited support to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs).
	Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.
Suggestions for addressing the challenges	• Value Chain: Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors.

	• Standards: Existing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training. • Aggregation: Partnerships between farmer cooperatives and African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs. • Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine where there is no value chain • Environmental conditions – Use of pesticides • Policy conditions – Lacking specific African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – Supporting youth, females and males in production and marketing African

	night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling – Supporting youth, females and males in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
Gender related opportunities	• Providing incentives to youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Adoption and scaling up - Supporting VMGs in production and marketing African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine
VMG related opportunities	• Providing incentives to VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

TIMP Name	**Participation in the County Integrated Development Planning**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Poor performance of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine sub-sector in Marsabit county leading to low African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production/ productivity and income
What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Finger millet production, marketing and processing are considered. ..
Justification	Agriculture is the main economic activity in Marsabit County. The county is Kenya's largest producer of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine, producing approximately 40%. This has significant implications on income generation, food security and poverty reduction efforts in the county. Therefore African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine is a major cash crop considered in the Marsabit county integrated development plan (CIDP). Smallholder farmers' failure to participate during the planning of the County Integrated Development would lead to omission in the development funding and implementation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data

	• County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders Universities
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri
Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the
	community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the

	poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The project offers support to all categories of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine producers including the VMGs
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Ready for up scaling
Lead organization and scientists	
Partner organizations	

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	The existing policy instruments do not centralize the smallholder farmers' issues in African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production. Therefore, weak policy instruments lead to market failure for both inputs and outputs
What is it? (TIMP description)	Agricultural policy is implemented through instruments which are the intervention points. Therefore, the policy instruments are the means to achieve policy objectives
Justification	Without policy instruments related to African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine production, farmers will remain without support in the agro-enterprise and market development. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability may lack centralization of the smallholder farmers agency and voices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders • Universities - sensitization
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos,Kitui, Makueni, Kakamega and Nyeri

Counties where TIMPs will be up scaled	Kakamega and Nyamira
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups. • Adoption and scaling – The county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups.
Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights. • Supporting youth, females and males in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males

VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – the county will encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling up - inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
VMG related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Nutritional project implemented in Machakos, Kitui and Makueni Counties
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDP
- Farmer accessibility to production inputs
- Improvement on households' livelihood

TIMP Name	**Policy cycle**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	

Problem addressed	Lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy leading to low productivity due to low adoption of quality inputs and poor marketing channels
What is it? (TIMP description)	Policy cycle involves problem definition or concerns, formulation, implementation and evaluation components
Justification	Policy cycle is used in the formulation and implementation of agricultural policies for the agriculture and rural development. Due to lack of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy, policy cycle can be used in the formulation and implementation and evaluation of outcome. African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain has specific policy concerns which can be identified at the stage of problem definition in the policy cycle. The issues are addressed at the implementation stage. As the implementation goes on, there is need for an evaluation at the evaluation stage to determine the success of the policy. The cycle completes by the establishing of the failure in to achievement the objectives or goals of the development agenda.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Public participation meetings
Critical/essential factors for successful promotion	• Availability of stakeholders • African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine policy concerns • Level of understanding of stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • County extension staff - sensitization of stakeholders
	• NGOs – sensitization of stakeholders • Private sector (local traders and exporters) – provide information on the problems in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain • Research institutions – sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kakamega and Nyamira

Challenges in development and dissemination -	• Lack of spearheading in the policy formulation • Lack of organized forums • Inadequate information to stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain
Suggestions for addressing the challenges	• Lack of spearheading in the policy formulation – the agricultural department in the county should take the initiative to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is in place • Lack of organized forums - formation of stakeholder forums consisting of well-informed participants. • Inadequate information to stakeholders – sensitization of stakeholders • Poorly established African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain – active participation by the actors in the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine value chain.
Lessons learned in up scaling if any	For the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry to progress, there is need for a African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – social inclusion • Environmental conditions – environmental conservation strategies to be highlighted in the policy • Policy conditions – to ensure African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine specific policy is formulated and implemented • Market conditions – within the policy framework
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs of Amaranth production per acre KES 7,400
Estimated returns	An amaranth can fetch up to 1200 kilograms per acre. A kilogram of amaranth is priced at around Ksh300. Estimated revenue KES 360,000
Gender issues and concerns in development and dissemination, adoption and scaling	• Development and dissemination – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups • Adoption and scaling – The policy should facilitate the benefits to members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups

Gender related opportunities	• All community members including the most vulnerable, the poor, the women, People with Disability and youth will be enjoy equal opportunities and rights • Supporting youth, females and males in the production • and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• Development and dissemination – The policy should facilitate the benefits to vulnerable and marginalized groups • Adoption and scaling up - The policy should facilitate the benefits to vulnerable and marginalized groups
VMG related opportunities	• People with Disability will be enjoy equal opportunities and rights • Supporting VMGs in the production and marketing of African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine. • Increased income of VMGs • Increased employment of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; Wambua J.M,.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers 3 Farmer accessibility to production inputs.
- Sustainability of the African night shade, Amaranth, Spider plant, Slender leaf, Cowpea, Jute mallow and Pumpkine industry

7.13 Good Agricultural Practices and Food Safety Management System

TIMPs name	Good Agricultural Practices (GAP
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Detection of food contaminants in both fresh produce, including AIV's, has been rampant. This results in declining food safety and quality, therefore frustrating sustainable farming of these crops for both food and income generation. Most markets continue to impose more stringent measures (to ensure the safety of consumers) for those wishing to access the said markets. These contaminants also impact negatively on the environment, worker safety and health; and consequently making it difficult to implement traceability, as most producers do not give accurate information on inputs and processes used during production, to avoid commercial losses and even prosecution
What is it? (TIMP description)	It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards (It is not about a specific crop production, but the process through which production takes). The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. Commercialization of AIV's on the domestic and future export level highly depends on compliance to these market standards
Justification	There is need to arrest the rampant detection of food contaminants in AIV's. Good Agricultural Practice(s) (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture [by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM)] to continuously improve farming systems. GAP is of utmost importance in protecting consumer health by ensuring safety throughout the food chain. It needs to be enforced and transparent, not only from the table but also upstream to include suppliers (e.g. quality of fertilizers and plant protection products) and all the value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, and larger plot demonstrations.

Critical/essential factors for successful promotion	Policy support from government particularly the enforcement of KS1758 (a domestic scope standard that has been passed after undergoing public participation stage).
Partners/stakeholders for scaling up and their roles	Producer organizations (FPEAK, FPC, KFC, AGAK etc), NGO's, MOALID, Private extension providers, CoG, and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	Already promoted in Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasingishu, Nakuru, Kericho, Bomet and other horticultural hot spots
Counties where TIMP will be up scaled	All counties in Kenya particularly where AIV's is grown
Challenges in dissemination	• Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Difficult to put monetary gains figures as most involves social and welfare issues in addition than markets lost due to non-compliance
Estimated returns	Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have less access to factors of production like land and credit • In most households, it is the men who make decision on what to do and how it is done ▪ Women may not have time and mobility to attend trainings and other extension activities far from home or held at times when they are performing other domestic roles ▪ Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles ▪ Women might not be aware of GAPs due to their low level of education and the social economic status ▪ There is need for all the stakeholders to be sensitized in GAPs to achieve good profits from their AIV's products
Gender related opportunities	• Agro-enterprise development by youth, females and males based on GAPs • Increased income due to improved income as a result of using GAPs by the youth, females and males

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to GAPs as they are not given chances to participate in agricultural trainings and workshops • VMGs have less access to farmer organization • VMGs have less access to farm implements VMGs have limited access credit to purchase the required GAPs • VMGs have limited access to training on GAPs and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination of GAPs • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Agro-enterprise development by VMGs based on GAPs • Increased income due to improved yield because of using GAPs, market access for the VMGs • Increased employment for VMGs and improved food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Small, holders in groups in the counties of Kirinyaga, Nyeri, Meru, Nakuru and other counties have been able to produce and export produce from horticultural crops that are certified after adopting and complying with GAP's.
Application guidelines for users	• Global GAP Version 6 (Code Ref: IFA V5.2_Feb19; English Version Versionn /Edition Update Register Page: 45 of 45) - https://www.globalgap.org/.content/.galleries/documents • KALRO-USAID Training And Extension Manual On Good Agricultural Practices (Gap) - Nov. 2017
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	• Director, KALRO Seed –Thika; info.ptc@kalro.org • Centre Directors; KALRO Kandara, • KALRO NSRC; • Director General KALRO
Lead organization and scientists	KALRO: Nyaga A., Ndungu J., Gatambia E., Kambo C., Kuria, S Musyoki R. Wasilwa, L., Kirigua, V., Muriuki SJN.
Partner organizations and their roles	MoALF&I, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's, Universities

TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for AIV's Value Chain in Kenya**
Category(i.e. technology, Innovation or management practice)	Management Practice

A: Description of the technology, innovation or management practice	
Problem addressed	The presence of chemical, biological and physical hazards within the AIV's value chain in Kenya have a direct effect on consumer's health. There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in AIV's value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the AIV's supply from biological, chemical and physical hazards into the hands of food management systems. The system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls.
Justification	There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of Escherichia coli (E. coli), Salmonella spp., Aspergillus flavus and Aspergillus parasiticus. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects. There is need to put in place risk analysis and hazard monitoring and management system to ensure that food contaminants are kept at bay along the AIV's value chain. Presence of these contaminants not only poses serious risks to human health and trade. Such tools are used globally and even adapted by Codex Alimentarius as a global acceptable FSMS. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range as required. Parameters will be quantified for production, harvesting, processing, distribution and value addition
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	AIV's value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• Training of stakeholders on GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP) • AIV's innovation platforms • FFBS sessions

	• Through common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).
Critical/essential factors for successful promotion	• Formation of "experts" team composed of HACCP specialists, food scientists, microbiologists, representative of the AIV's (and other similar crops) value chain players, public health officers, and a quality control and safety specialists from the competent authorities to guide the process • Local and National governments support
Partners/stakeholders for scaling up and their respective roles.	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players • Farmers/farmer groups • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • National competent authorities • Analytical testing services • Processors and local traders
C: Current situation and future scaling up	
Counties where already promoted if any	• Not promoted in any county of Kenya
Counties where TIMPs will be up scaled	• All counties growing and consuming AIV's in Kenya.
Challenges in development and dissemination	• Inadequate funds to reach value chain actors • New concept not very well known among the primary stakeholders and market outlets
Suggestions for addressing the challenges	• Funding of dissemination platforms • Training of all stakeholders on food safety
Lessons learned in up scaling, if any	• None since scaling up has not been done
Social, environmental, policy and market conditions necessary for development and up-scaling	• AIV's being observed by stakeholders as a food and commercial crop that requires protection from contamination • Use of less toxic crop protection methods in handling crop health issues • Establishment of practical and acceptable food handling protocols at both county and National levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth might not be aware of the existing hazards, their preventive measures and control

	• Women and youth might to be aware of the impact identified hazards could have to their health • In harvesting and processing AIV's to meet the acceptable national standards, women and youth play critical roles. • Therefore, there is need to build the capacity of women and youth in the identifications of food safety hazards/risks and the control measures along AIV's value chain • Women and youth lack finances
Gender related opportunities	Opportunities exist for women and youth in the marketing and use of AIV's and it's by products as an entrepreneurship.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • VMGs have limited participation in decision making at community and County level • Require strategies that target the VMG during scaling up of the AIV's value chain.
VMG related opportunities	• Identification of critical limits to be defined • Control measures to be identified • Criteria for compliance already clearly defined for adoption
○ **E: Case studies/profiles of success stories**	
Success stories	N/A
Application guidelines for users	• HACCP general guidelines - https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/ • General principles of food hygiene - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%25253A%25252F%25252Fworkspace.fao.org
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3 . Requires further research)	Ready for up scaling;
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Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, KEBS, County governments, NGO's and Universities.

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