Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Cabbage Value Chain

Masinde A.A.O., Opondo R., Otipa M., Muriuki S.J.N., Ndung'u B., Odhiambo H., Too A., Ndambuki J., Ndubi J., Kamau G., Mwangi H.W., Esilaba A.O., Wayua F.O., Nasirembe W.W., Ochieng V., Ong'amo G., Chacha D., Maina S.M., Kimani S.K., Momanyi V.N., Ochieng B.O., Amata R.L., Kirigua V.O. and Wasilwa L.A.

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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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KALRO Secretariat
P O Box 57811-00200
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Email: directorgeneral@kalro.org Tel. No(s): +254-722206986/733333223

Compiled by: Masinde A.A.O., Opondo R.T., Otipa M., Muriuki S.J.N., Ndung'u B., Odhiambo H.O., Too A.K., Ndambuki J., Ndubi J., Kamau G., Mwangi H.W., Esilaba A.O., Wayua F., Nasirembe W.W., Ochieng V., Ong'amo G., Chacha D., Maina S.M., Kimani S.K, Momanyi V.N., Otieno B., Amata R., Kirigua V.O. and Wasilwa L.A.

Editors: Ouda J.O., Mukundi K.T., Mwirigi M., Nyabundi K.W., Maina P., Ayemba J., Wanyama H.N. and Kedemi R.M., Omondi S.P., Maina F and Masinde A.A.O.

Editing and Publication Coordination: Kirigua V.O. and Lung'aho C.

Design and layout: Nyaola E. and Mnene N.

Typesetting:
Mueni G.

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 cabbage 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 cabbage 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 cabbage), cereals (sorghum, millet, maize, teff) nuts (cashew 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, Kakemega, 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 cabbage 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.

Francis Muthamia
National Project Coordinator
Kenya Climate-Smart Agriculture Project

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ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semi-Arid Lands
ASK	Agricultural Society of Kenya
CBOs	Community based organization
CGIAR	Consultative Group for International Agricultural Research
CSA	Climate Smart Agriculture
FBO	Farmer Based Organization
FFBS	Farmer Field and Business School
FFS	Farmer Field School
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
HACCP	Hazard Analysis and Critical Control Points
ICM	Integrated Crop Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IPM	Integrated Pest Management
ISDA	Innovative Solution for Decision Agriculture
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate-Smart Agriculture Project
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Pant Heath Inspectorate Service
MoALFC	Ministry of Agriculture, Livestock, Fisheries and Cooperatives
NARI	National Agricultural Research Institute
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organization
PCPB	Pest Control Products Board

TIMPs	Technologies, Innovation and Management Practices
ToT	Training of Trainer
VMG	Vulnerable and Marginalized Group
Kg	Kilogram

1.0 DEFINITION OF TERMS AND SUMMARY TABLES OF CABBAGE TECHNOLOGIES, INNOVATIONS AND MANAGEMENT PRACTICES (TIMPs)

1.1 Definition of terms

Technology: This is an output of a research process which is beneficial to the target clientele (mainly farmers for KCSAP's case), can be commercialized and can be patented under intellectual property rights (IPR) arrangements. It consists of research outputs such as tools, equipment, genetic materials, breeds, farming and herding practices, gathering practices, laboratory techniques, models etc.

Management practice: This is a recommendation on a practice that is considered necessary for a technology to achieve its optimum output. It includes different agronomic practices (seeding rates, fertilizer application rates, spatial arrangements, planting period, land preparation and watering regimes), crop protection for crops and feed rations and disease control for livestock.

Innovation: This is a modification of an existing technology for an entirely different use from the original intended use. (e.g., fireless cooker modified to be used as a hatchery)

1.2 Summary of inventory of TIMPs in the cabbage value chain

The inventory process identified 121TIMPs comprising 47 technologies, 20 innovations and 54 management practices, distributed among the 12 sub-themes, as indicated in the table 1.

Table 1. Summary of Cabbage TIMPs

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practice
Cabbage	Improved Cabbage varieties	13	0	0
Cabbage	Cabbage seed system	1	0	0
Cabbage	Food Safety Management system	0	0	2
Cabbage	Agronomic management practices	0	0	9
Cabbage	Soil Fertility Management	3	1	0
Cabbage	Soil and Water Management	12	1	3
Cabbage	Cabbage Crop health	4	3	25
Cabbage	Postharvest management	4	0	2
Cabbage	Cabbage Value addition	2	14	0
Cabbage	Mechanization of Cabbage production activities	8	1	1
Cabbage	Cabbage business and Marketing	0	0	8
Cabbage	Agricultural Policy	0	0	4
Total		**47**	**20**	**54**

.3 Summary of Status of TIMPs in Cabbage Value Chain

The inventory process resulted in a total of 121 TIMPs, 71 that are ready for up-scaling, 45 TIMPs that require validation and 5 TIMPs that require further research in the sub-themes, as indicated in Table 2.

Table 2. Number of Cabbage TIMPs ready for up-scaling, require validation or further research

Commodity/VC	Sub-Theme	Ready for up-scaling	Require validation	Further Research
Cabbage	Improved Cabbage varieties	13	0	0
Cabbage	Cabbage seed system	1	0	0
Cabbage	Food Safety Management systems	2	0	0
Cabbage	Agronomic management practices	9	0	0
Cabbage	Soil Fertility Management	0	4	0
Cabbage	Soil and Water Management	9	5	2
Cabbage	Cabbage Crop health	17	12	3
Cabbage	Postharvest management	2	4	0
Cabbage	Cabbage Value addition	6	10	0
Cabbage	Mechanization of Cabbage production activities	8	2	0
Cabbage	Cabbage business and Marketing	2	6	0
Cabbage	Agricultural Policy	2	2	0
Overall Total		**71**	**45**	**5**

Table 3. Inventory of Cabbage TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 **Cabbage** varieties	2.1.1 Copenhagen (Heat tolerant variety)	Technology	Ready for Up-scaling
	2.1.2 Pretoria F1 variety (Heat tolerant variety)	Technology	Ready for Up-scaling
	2.1.3 Fiona F1 hybrid variety: (Heat tolerant and early maturing variety)	Technology	Ready for Up-scaling
	2.1.4 Pruktor F1": F1 variety: (Temperature tolerant)	Technology	Ready for Up-scaling
	2.1.5. Typhoon F1 variety: (Heat tolerant)	Technology	Ready for Up-scaling
	2.1.6. Chinese cabbage (Early maturity)	Technology	Ready for Up-scaling
	2.1.7 Green Challenger F1 cabbage variety (Early Maturing)	Technology	Ready for Up-scaling
	2.1.8 Baraka F1	Technology	Ready for Up-scaling
	2.1.9 Blue Dynasty F1 cabbage	Technology	Ready for Up-scaling
	2.1.10 Golden Acre cabbage variety	Technology	Ready for Up-scaling
	2.1.11 Ruby Perfection F1 cabbage variety (Cold and hot temperature tolerant)	Technology	Ready for Up-scaling
	2.1.12 Gloria F1 cabbage variety	Technology	Ready for Up-scaling
	2.1.13 Riana F1 Cabbage variety (Heat	Technology	Ready for Up-

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	and cold tolerant)		scaling
2.2 Cabbage seed system	2.2.1. Formal Seed system	Technology	Ready for Up-scaling
2.3 Food Safety Management System	2.3.1 Good Agricultural Practice (GAP) for cabbage	Management practice	Ready for Up-scaling
	2.3.2 Hazard Analysis Critical Control Points (HACCP) Plan for cabbage Value Chain in Kenya	Management practice	Ready for Up-scaling
2.4 Agronomic management practices	2.4.1 Site selection	Management practice	Ready for Up-scaling
	2.4.2 Land preparation	Management Practice	Ready for upscaling
	2.4.3 Planting/transplanting cabbage	Management practice	Ready for Up-scaling
	2.4.4 Fertilizer application	Management practice	Ready for Up-scaling
	2.4.5 Water Requirement	Management practice	Ready for Up-scaling
	2.4.6 Pest management	Management practice	Ready for Up-scaling
	2.4.7 Weed management	Management practice	Ready for Up-scaling
	2.4.8 Crop rotation for increased yield	Management practice	Ready for Up-scaling
	2.4.9 Harvesting	Management practice	Ready for Up-scaling
2.5 Soil fertility management	2.5.1 Integrated Manure Management (IMM)	Complementary technology	Requires validation
	2.5.2 Integrated Soil Fertility	Complementary	Requires

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	Management (ISFM)	technology	validation
	2.5.3 Rapid soil testing services	Innovation	Requires validation
	2.5.4 Low Cost Composting	Technology	Require validation
2.6 Soil and water management	2.6.1 Contour bands	Technology	Requires validation
	2.6.2 *Zai* Pits	Technology	Requires validation
	2.6.3 Bench terraces	Technology	Ready for Upscaling
	2.6.4. *Fanya Juu* terraces	Technology	Ready for Upscaling
	2.6.5. Stone lines	Technology	Ready For Upscaling
	2.6.6 Retention ditches	Technology	Ready Upscaling
	2.6.7 Grass strips	Technology	Ready for upscaling
	2.6.8 Tied ridges /Ridging /Earthing	Technology	Ready Upscaling
	2.6.9 Rain water harvesting systems (ponds and dams)	Management practice	Ready for up-scaling
	2.6.10 Conservation Agriculture (CA)	Management practice	Ready for up-scaling
	2.6.11 Cabbage-legume intercropping	Management	Requires

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
		practice	further research
	2.6.12 Mulching	Technology	Requires further research
	2.6.13 Drip irrigation systems for small scale farmers	Technology	Ready for up-scaling
	2.6.14 Solar Irrigation For smallholder Farmers	Innovation	Requires validation
	2.6.15 Hydroponic Technology	Technology	Requires validation
	2.6.16 Agroforestry For soil Fertility	Technology	Require validation
2.7 Cabbage Crop Health	**2.7.1 Cabbage Insect Pests**		
	2.7.1.1 Integrated Pest Management of Diamond back moth (*Plutella xyllostellla*) in cabbage	Management practice	Ready for up-scaling
	2.7.1.2 Integrated Pest Management of Red Spider mite *(Tetranychus spp)* in cabbage	Management practice	Ready for upscaling
	2.7.1.3 Integrated pest management of cutworm *(Agrotis sp.)* in Cabbage.	Management practice	Ready for Upscaling
	2.7.1.4 Integrated management of cabbage saw fly *(Athalia sjostedti)* in cabbage	Management practice	Ready For Upscaling
	2.7.1.5 Integrated management of cabbage aphids *(Brevicoryne brassicae)* in cabbage.	Management practice	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.7.1.6 Integrated management of cabbage root maggot *(Delia radicum)* **in cabbage**	Management practice	Ready for upscaling
	2.7.1.7 Integrated pest management of cabbage loppers *(Trichoplusia in)* in cabbage	Management Practice	Ready for upscaling
	2.7.1.8 Control of Cabbage web worm using Integrated Pest Management Practices	Management practice	Ready for upscaling
	2.7.1.9 Integrated management of flea beetles *(Phyllotreta striolata)* in cabbage	Management practice	Ready for upscaling
	2.7.1.10 Integrated management of head caterpillar *(Crocidolomia pavonana)* in cabbage	Management practice	Ready for upscaling
	2.7.1.11 Intercropping cabbages with garlic to control Cabbage head caterpillar	Technology	Requires further research.
	2.7.1.12 Use of plant extracts for control of cutworms in cabbage	Innovation	Requires further research
	2.7.1.13 Evaluation of pesticides to control flea beetles in cabbage	Management practice	Requires further research.
	2.7.1.14 Community rangeland rehabilitation to increase populations of natural enemies for pest management in cabbage.	Management practice	Requires validation
	2.7.2 Cabbage Diseases		
	2.7.2.1 Integrated Management of damping off disease in cabbage	Management practice	Requires validation
	2.7.2.2 Integrated Management of Black rot (*Xanthomonas campestris* pv. *Campestris*) of cabbage	Management practice	Requires validation
	2.7.2.3 Integrated management of Leaf spot diseases (*Alternaria* sp and	Management	Require

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	Mycosphaerella brassicicola) of cabbages in cabbage	practice	validation
	2.7.2.4 Integrated Management of black leg (*Phoma lingam*) disease of cabbages	Management Practice	Requires validation
	2.7.2.5 Integrated Management of bacterial soft rot disease of cabbage (*Pectobacterium carotovorum subsp. carotovorum*.) disease of crucifers	Management Practice	Ready for upscaling
	2.7.2.6 Integrated Management of downy mildew (*Peronospora* spp.) diseases of cabbage.	Management Practice	Requires validation
	2.7.2.7 Integrated Management of club root (*Plasmodiophora brassicae*) disease of cabbages	Management Practice	Ready for upscaling
	2.7.2.8 Integrated Management of powdery mildew (*Erysiphe crucifer arum*) disease of cabbages	Management Practice	Requires validation
	2.7.2.9 Seed dressing in cabbage for control of crickets.	Technology	Requires validation
	2.7.2.10 Quarantine and movement restriction for management of Bacterial soft rot and Black rot in cabbages.	Management practice	Requires validation
	2.7.3 Weed Management in Cabbage		
	2.7.3.1 Integrated Weed Management in Cabbage	Innovation	Ready for upscaling
	2.7.3.2 Cabbage Intercropping System for weed control	Innovation	Requires Validation
	2.7.3.3 Mulching for weed management	Management practice	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.7.3.4 Chemical Weed Control	Management practice	Ready for upscaling
	2.7.3.5 Mechanical weed control	Management practice	Ready for upscaling
	2.7.3.6 Solarization Bed for Weed Control	Technology	Requires Validation
	2.7.3.7 Stale seed bed for Weed Control	Technology	Requires Validation
	2.7.3.8 Safe Use of herbicides	Management practice	Ready for upscaling
2.8 Postharvest management of Cabbage	2.8.1 Harvesting	Management practice	Ready for Up scaling
	2.8.2 Sorting and Grading	Management practice	Ready for up-scaling
	2.8.3 Zero Energy Brick Cooling Chamber	Technology	Requires validation
	2.8.4 CoolBot™	Technology	Requires validation
	2.8.5 Wakati™	Technology	Requires validation
	2.8.6 Modified atmosphere packaging	Technology	Requires validation
2.9 Cabbage Value Addition	2.9.1 Flour	Innovation	Require validation
	2.9.2 Solar drying	Technology	Ready for up scaling
	2.9.3 *Prickle*	Innovation	Require validation
	2.9.4 *Juice*	Innovation	Require validation
	2.9.5 Salads	Innovation	Ready for up scaling
	2.9.6 Fermented cabbage	Innovation	Ready for up scaling
	2.9.7 Flaked	Innovation	Ready for up-scaling
	2.9.8 Canned	Innovation	Require validation
	2.9.9 Cabbage pancake	Innovation	Require validation
	2.9.10 Cabbage mandazi	Innovation	Require validation
	2.9.11 Cabbage Kimchi	Innovation	Require validation

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.9.12 Steamed cabbage	Innovation	Ready for up scaling
	2.9.13 Soup	Innovation	Ready for up scaling
	2.9.14 Buttered cabbage	Innovation	Require validation
	2.9.15 Cabbage cake	Innovation	Require validation
	2.9.16 Cabbage crackie	Innovation	Require validation
2.10 Mechanization of Cabbage production activities	2.10.1 Power tiller	Technology	Ready for up-scaling
	2.10.2 Wheeled tractor	Technology	Ready for up-scaling
	2.10.3 Moldboard plough	Technology	Ready for up-scaling
	2.10.4 Disc Harrow	Technology	Ready for up-scaling
	2.10.5 Multi-function seedbed ridging machine	Innovation	Require validation
	2.10.6 Cabbage direct Planter	Management Practice	Require validation
	2.10.7 seedling Tray Planter	Technology	Ready for upscaling
	2.10.8 Cabbage Trans planter	Technology	Ready for upscaling
	2.10.9 Motorized Sprayer	Technology	Ready for up-scaling
	2.10.10 Harvesting	Technology	Ready for up-scaling
2.11 Business and marketing	2.11.1 Models of organizing farmer groups	Management Practice	Ready for Up- scaling
	2.11.2 Profitability analysis	Management Practice	Ready for Up- scaling
	2.11.3 Market research	Management Practice	Requires validation
	2.11.4 Collective marketing	Management Practice	Requires validation
	2.11.5 Marketing innovation model	Management Practice	Requires validation
	2.11.6 Contracted Production Model	Management Practice	Requires validation

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.11.7 Digital Marketing	Management Practice	Requires validation
	2.11.8 Building a Business Plan For cabbage Production	Management Practice	Requires validation
2.12. Agricultural Policy options	2.12. National Agricultural Policy Strategies Framework for supporting Cabbage production and marketing	Management Practice	Ready for Upscaling
	2.12.2 Policy Cycle	Management Practice	Requires validation
	2.12.3 County Integrated Development planning	Management Practice	Ready for Upscaling
	2.12.4 Policy Instruments Related to Cabbage	Management Practice	Requires validation
	Total TIMPs	**121**	**121**

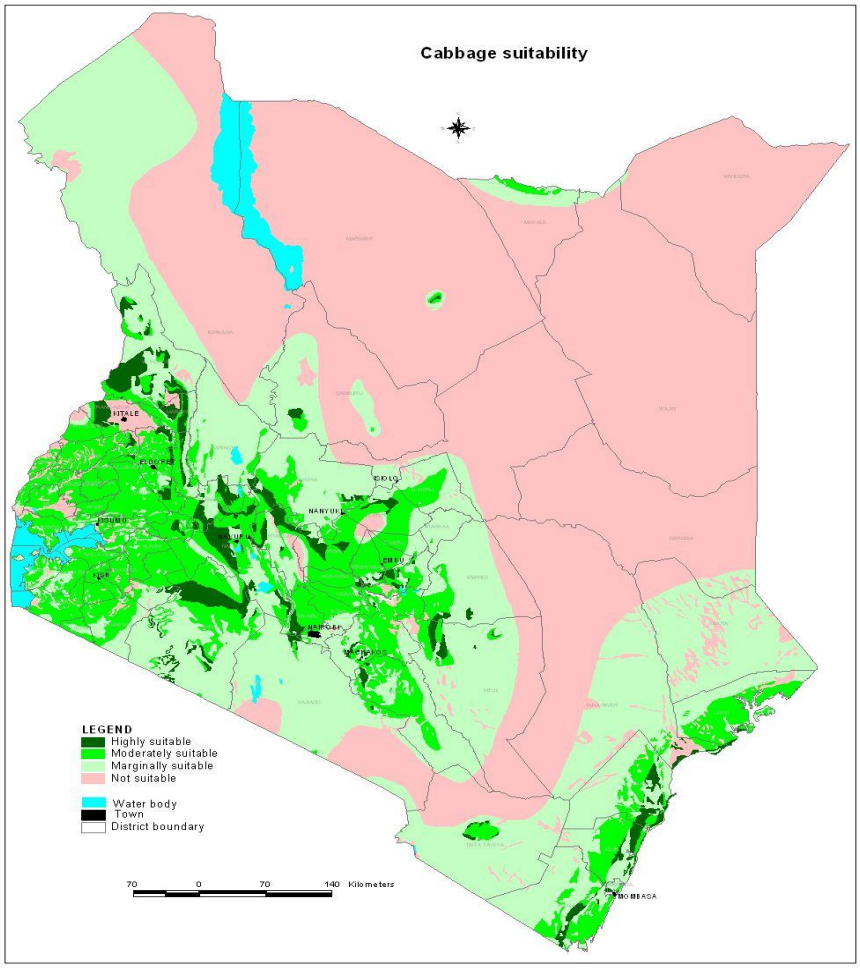


Figure 1 Suitability map of cabbage in Kenya

2.0 DETAILED CABBAGE VALUE CHAIN TIMPS

2.1 CABBAGE VARIETIES

2.1.1 TIMP Name	**Copenhagen Market variety: (Heat tolerant variety)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage Farmers have limited access to superior heat tolerant cabbage varieties which results to low yield and in some cases total losses
What is it? (TIMP description)	It is heat tolerant, and early maturing at 60-65 days it can produce heads of 1.5-2kg with 16,000kg-22,000kg/acre. The heads are medium to large and it has long harvest duration with long shelf life.
Justification	There is need for dissemination and promotion of more heat tolerant cabbage varieties to areas that are unsuitable for growing cabbages due to high temperature conditions to increase productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC /Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital media • AIPs –Agriculture information platforms
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Organization of well-structured market systems • County and National government support • Funding to research, validate and promote new cabbage varieties

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Syngenta, Seed co, Amiran, Simlaw, Kenya Seed Company, East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • National governments, county government e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors, AFC other credit facilitators for financial solutions.
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-(Mwea & Kagio), Kiambu-(Muguga and Lari.)
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado and Taita Taveta
Challenges in dissemination	• Inadequate agronomic management practices • Lack of awareness and information on suitable varieties • Inadequate awareness and information on suitable varieties • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level: is mainly known for making stew served with cereal-based meals • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed especially in rural areas • high seed cost due importation of seeds • Limited access to rural finance for bulk production
Suggestions for addressing the challenges	• Promotion of the suitable varieties in the areas Information • Dissemination on production practices • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Diamond back moth

Lessons learned in up-scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111seedlings/acre @ KES 2)= KES 22,222
Estimated returns	Returns per acre (16,000kg per acre @KES 10/kg) = KES 160,000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have limited access to farm inputs than men • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • 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 than men
Gender related opportunities	The relatively steady stream of income from cabbage production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). Cash generated from cabbage production by the various gender categories can be invested back in other agricultural enterprises such as other crops or livestock farming. The technology is acceptable and easy to upscale by both males and female gender Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns	• VMGs have limited access to land for cabbage cultivation than men

in development, dissemination, adoption and scaling up	• VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 11000kg/acre to 16000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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-Kitale, P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.**
Lead organization and scientists	KALRO scientists: Otipa M.J., Masinde A.A.O., Opondo R., Ndungu B.W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to develop and release more heat tolerant cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.2 TIMP Name	**Pretoria F1 variety (Heat tolerant variety)**
Category (i.e. technology, innovation or management practice)	Technology 

A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage Farmers have limited knowledge and access to superior heat tolerant cabbage varieties adapted to local conditions which results to low yield and in some cases total losses
What is it? (TIMP description)	It is an early maturing with uniform growth that matures at 70-75 days. The head weighs 4-5 kg with a yield of 45000-56000 kg/acres. The variety's heads have eexcellent wrapper leaves, high heat tolerance and it is dark green in colour and tolerant to *Fusarium wilt* (yellow).
Justification	There is need to promote heat tolerant and early maturing cabbage varieties for areas that have high temperatures and has potential to produce cabbages. This variety withstands extreme heat conditions and tolerates diseases such as Fusarium wilt which causes yield losses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Syngenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination

	• NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea & Kagio
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. *Cabbage looper*
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already “a climate change ready crop” due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply

	consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111seedlings/acre @KES 3) = KES 33,333
Estimated returns	Returns per acre (45,000kg per acre @ KES 10/kg) = KES 450,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. • Contact farmer in Kiambu county (Muguga) who participated in demos and now producing commercially, David Justus • Increase in production from 28000kg-45,000kg/acre

Application guidelines for users	**Reference:** Ochieng V., Wasilwa L., Kiprono C., Musembi, F.J. and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale. Food crop Research Centre-Muguga south,P.O BOX 30148-00100 Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.3 TIMP Name	**Fiona F1 hybrid variety: (Heat tolerant and early maturing variety)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage Farmers have limited knowledge on early maturing, heat and diseases tolerant varieties that are adapted to local conditions which results to low yield and in some cases total losses, due to choice of inappropriate variety for the area
What is it? (TIMP description)	• This is a cabbage variety with heads that are firm, compact and uniform weighing between 3-5 kg with a yield of 30000-50000 kg/acres. • It matures in 70 days after transplanting; five to ten days earlier than other medium head cabbages. • It has proved good tolerance to heat and resistance to splitting and

	bolting (good field holding capacity). • It has an excellent disease tolerance to black rot, cabbage yellows and ring spots.
Justification	There is need to promote early maturing and heat tolerant cabbage varieties to areas that do not grow this vegetable due to the hot climatic conditions.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors AFC, and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea & Kagio
Counties where TIMP will	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii

be up-scaled	
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. *Diamond back moth*
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 3) = KES 33,333
Estimated returns	Returns per acre (33,333kg per acre @ KES 10/kg) = KES 333,330
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage

	• Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. • Increase in production from 28000kg-30,000kg/acre
Application guidelines for users	**Reference** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale

	Food crop Research Centre-Muguga south,P.O BOX 30148-00100 Nairobi
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research and release more superior early maturing and heat tolerant cabbage varieties

2.1.4 TIMP Name	**Pruktor F1": F1 variety: (Temperature tolerant)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Awareness and availability of cabbage varieties that are tolerant to low temperatures, and are adapted to local conditions with acceptable level of diseases tolerance
What is it? (TIMP description)	• Pruktor F1 Cabbage is tolerant to low night temperatures. • Head is uniform in size and growth and matures at 70-75 days. • The head weighs 2-3 kg with a yield of 20,000 – 30,000 kg per acre. • resistance and tolerant to black rot and diamond back moth (DBM). • The population per acre is 11,111 plants.
Justification	There is need to promote early maturing and low temperature tolerant cabbage varieties to areas that do not grow this vegetable due to the low night temperatures in these areas.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied Research to release improved cabbage varieties • Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for

	cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua county
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems

	• Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Black rot
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @KES 2.5)= KES 27,776
Estimated returns	Lowest Returns per acre (22,000kg per acre KES 10/kg) = KES 220,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 11,330 kg/acre -16,000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
G. Contacts	
Contacts	Institute Director, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale Food crop Research Centre-Muguga south,P.O BOX 30148-00100 Nairobi
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more temperature tolerant varieties in the different regions

2.1.5 TIMP Name	**Typhoon F1 variety: (Heat tolerant)**
Category (i.e. technology, innovation or management practice)	Technology

	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Awareness and access to heat tolerant, disease resistance, ideal cabbage varieties for salad/value addition. This leads to low production and low productivity.
What is it? (TIMP description)	• Typhoon F1 matures fast and with uniform growth and matures at 70-75 Days. • The head weighs 4-5 kg with a yield of 45000-56000kg/acres. Excellent heat tolerance and it is dark green in colour and resistance and tolerant to *Fusarium yellow*.
Justification	There is need to promote and increase production and productivity of early maturing, heat tolerant, disease resistant cabbage varieties, that are also ideal for value addition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and

	International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea & Kagio
Counties where TIMP will be upscale	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. *Diamondback moth*
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing.

development and up scaling	• It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 3)= KES 33,333
Estimated returns	Returns per acre (44,000kg per acre @KES 10/kg) = KES 440,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization

	of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. • Increase in production from 28,000kg to 32,000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale Food crop Research Centre-Muguga south,P.O BOX 30148-00100 Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties'

Evaluation of more heat tolerant varieties in the different regions

2.1.6 TIMP Name	**Chinese cabbage (Early maturity)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited information, knowledge and access to early maturing varieties that are tolerance to diseases and can be used in salads.

What is it? (TIMP description)	Chinese Cabbage an eexcellent head forming variety with attractive size ideal for growing in both warm and cool regions. The large savoyed leaves with thick succulent midribs possess a sweet taste and crisp texture when eaten raw. Chinese cabbage has a flavor somewhat milder than cabbage when cooked. It is traditionally favored for pickling, soups and stir-fry medleys, it can substitute adequately for cabbages in modern dishes. The variety has notable field tolerances against turnip mosaic and turnip yellow mosaic virus and intermediate tolerance to downy mildew. It matures in 60 – 70 days after transplanting with a yield potential of 20000kg – 25000kgs/acre
Justification	It is an ideal cabbage variety to promote since it is an early maturing cabbage variety that can be utilized in salads, sandwiches and in soups in modern dishes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and

	mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu county –Muguga, and Kimende
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level; is mainly known for making stew served with cereal-based meals • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Black rot
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already “a climate change ready crop” due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Cost of seedlings per acre (11,111/acre @ KES 3.5)= KES 38,880
Estimated returns	Returns per acre (20,000kg per acre @ KES 20) = KES 400,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 16,330kg/acre-20000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L., Kiprono C., Musembi, F.J. and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
F: Status of TIMP readiness (1-ready for up-scaling;, 2-requires validation; 3-requires	Ready for up scaling

further research**)**	
G. Contacts	
Contacts	Institute Director, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.7 TIMP Name	**Green Challenger F1 cabbage variety (Early Maturing)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Diamond Back Moth is a serious pest of cabbage and cause total crop loss. Green challenger F1 has tolerance to *diamond back moth*, *black rot* and *Fusarium wilt,* therefore if accessed by farmers can increase productivity
What is it? (TIMP description)	• This is a blue green colour with rich creamy internal colour. • Tolerant to diamond back moth (DBM), black rot & Fusarium yellows. • It matures at 60 days after transplanting hence early maturing. • Head is round shaped with compact size, weighing 1.4-1.6 kg and yields 20,000-30,000 kg per acre.
Justification	There is need to promote early maturing cabbage varieties that are tolerant to diseases that is causing up to 100% yield losses for farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.

Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua county
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties

	• Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre KES 2)= KES 22,222
Estimated returns	Returns per acre (20,000kg per acre @ KES 10) = KES 200,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men

	• Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 11330kg- 16000/acre
Application guidelines for users	**Reference** Ochieng V., Wasilwa L., Kiprono C., Musembi, F.J. and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.8 TIMP Name	Baraka F1
	Technology  *Source: Robert Opondo*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage farmers are faced with many pest including the emerging ones which causes drastic decline in yields. There is therefore need to promote high yielding and disease tolerant cabbage varieties.
What is it? (TIMP description)	• This is a high yielding bluish green round heads weighing 4-6 kg that matures at 75 days. • It has a good field holding capacity and has high tolerance to black rot, ring spot and cabbage *Fusarium yellows*. • It has good ground clearance and yields 40,000-50,000 kg per acre.
Justification	There is need to promote early maturing and high yielding cabbage varieties that are tolerant to a variety of pest and diseases.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Syngenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed,

	Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu and Meru
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production
Suggestions for addressing the challenges	• Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Black rot
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already “a climate change ready crop” due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply

	• Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 3/seedling)= KES 33,333
Estimated returns	Returns per acre (40,000kg per acre @ KES 10/kg) = KES 400,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 40,000kg - 50,000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F.J. and Wadenje J. 2015.

	Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

Validation and promotion of the variety in the target areas of Cabbage cultivation

2.1.9 TIMP Name	**Blue Dynasty F1 cabbage**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited pest and disease tolerant cabbage varieties has lead the yield decline, high production costs and consumption of unsafe foods due to frequent chemical sprays as control measures.
What is it? (TIMP description)	• This cabbage varieties has good tolerance to black rot, cabbage ring Spot, diamond back moth (DBM) & *Fusarium yellows*. • It can do well in warm areas and matures at 80-85 days after transplanting (medium-late maturing). • The head is round compact shape and weighs 4-5 kg with a yield of 45,000-68,000 kg per acre.
Justification	There is need to promote cabbage varieties that have pest and disease tolerance.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days

	• Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea & Kagio
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly

	known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Black rot
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 3/seedling) = KES 33,333
Estimated returns	Returns per acre (45,000kg per acre @ KES 10/kg) = KES 450,000
Gender issues and concerns in development and dissemination	• Labour intensity in planting, weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in cabbage • Slow information and awareness flow to female farmers due to academic levels • Women may not be able to reach far way markets or have bargaining power • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men

Gender related opportunities	• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Employment opportunities exist for youths males and men in cabbages production, spraying and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • 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. • There is low adoption by VMGs due lack of awareness. • VMGs may also have limited access to finances to buy the required inputs such as seeds than men
VMG related opportunities	• Employment opportunities exist for some VMGs such as youths' males in cabbages production, spraying and marketing • Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 45,000kg/acre-68,000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.10 TIMP Name	**Golden Acre cabbage variety**
Category (i.e. technology,	Technology

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage farmers in Kenya require cabbage varieties with good marketability characteristic, tolerant to drought, pest and diseases. and have versatile usage such as salad, can be processed and stew preparation
What is it? (TIMP description)	• It is ssuited to low-medium altitude (800-2000m), high altitude in short rain season, has small-medium heads, good marketability. • Matures in 8-10 weeks. Head weight: 1.5-2 kg and yield of 40-60 t/ha.
Justification	There is need to promote early maturing cabbage varieties with good marketability characteristics with multiple usage, that is drought tolerant
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company

	• Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu and Meru
Counties where TIMP will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. *Diamond back moth*
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already “a climate change ready crop” due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption

	importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (15,000/acre @ KES 2/seedling)= KES 30,000
Estimated returns	Returns per acre (22,500kg per acre @ KES 10/kg) = KES 225,5000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have limited access to farm inputs than men • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • 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 than men
Gender related opportunities	• The relatively steady stream of income from cabbage production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). • Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • The technology is acceptable and easy to upscale by both males and female gender • Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization

	of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 11330kg/acre-16000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties

Evaluation of more heat tolerant varieties in the different regions

2.1.11 TIMP Name	**Ruby Perfection F1 cabbage variety (Cold and hot temperature)**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage farmers in Kenya do not have superior cold and hot temperature purple coloured varieties that are tolerant to diseases. This is because there is limited research and promotion of the crop.
What is it? (TIMP description)	• This is a late red cabbage. The heads are medium-size and dense with a uniform high-round shape and good wrapper leaves. • Good field-holding ability. • Matures just in time for late summer crops or fall harvest for medium-term storage. Average weight is 2.5 kg and is resistant to thrips. • It is used for salads.
Justification	It is important to promote cabbage varieties that can be used in salads and are

	cold, heat and pest tolerant.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied Research to release improved cabbage varieties • Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Syngenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nairobi county
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the

	household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (8000seedlings/acre @ KES 4)= KES 32,000
Estimated returns	Returns per acre (20,000kg per acre @ KES 20/kg) = KES 400000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have limited access to farm inputs than men • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men

	• The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • 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 than men
Gender related opportunities	• The relatively steady stream of income from cabbage production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). • Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • The technology is acceptable and easy to upscale by both males and female gender • Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 12000kg to 20kg per acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up-scaling
G. Contacts	
Contacts	Institute Director, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale

Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

1. Research to release more superior cabbage varieties
2. Evaluation of more heat tolerant varieties in the different regions
3. Validation and promotion of the variety in the target areas of Cabbage cultivation

2.1.12 TIMP Name	**Gloria F1 cabbage variety**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Black rot and *Fusarium yellows diseases in cabbage* are reported to cause 100% yield loss in most cabbage growing areas. Gloria F1 cabbage is tolerant these disease making it a good candidate for increasing cabbage yield
What is it? (TIMP description)	• Gloria F1 matures in 90 days after transplanting. • The leaves have a solid blue-green colour, with a thick waxy layer. • Gloria F1 keeps well after harvesting and is not prone to splitting. • It is tolerant to black rot and resistant to *Fusarium yellows*. • Heads weigh between 5-6kg with a yield of 50000 kg - 60000 kg/acre
Justification	There is need to promote cabbage varieties that are tolerant to black rot disease and *Fusarium yellow* which is not controlled can cause 100 yield loss for farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied Research to release improved cabbage varieties • Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for

	cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua and Narok county
Counties where TIMP will be up-scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems

	• Available varieties not tolerant to heat stress which is a constraint in the new target areas • Not tolerant to emerging pests e.g. Black rot
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 2.5/seedling) KES 27,777
Estimated returns	Returns per acre (44,,000kg per acre @ KES 10/seedling) = KES 440,000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have limited access to farm inputs than men • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • 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 than men
Gender related opportunities	• The relatively steady stream of income from cabbage production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). • Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such

	as other crops or livestock farming. • The technology is acceptable and easy to upscale by both males and female gender • Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. Increase in production from 20,000kg/acre-40000kg/acre
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties that are tolerant to black root disease

Evaluation of more heat tolerant varieties in the different regions

2.1.13 TIMP Name	**Riana F1 Cabbage variety (Heat and cold tolerant)**
Category (i.e. technology, innovation or management practice)	Technology

	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Cabbage farmers in Kenya do not have superior heat tolerant varieties adapted to local conditions with acceptable head characteristics This is because there is limited such cabbage varieties and limited promotion of the variety.
What is it? (TIMP description)	• This is both heat and cold tolerant and has a blue green, white internal colour. • It is resistant to splitting when irrigated or rain fed and matures at 90-100 days after transplanting • It has a round and compact head and weighs 1.5-2.5 kg. • It is tolerant to black rot and tip burn with a yield of 12000-20,000 kg per acre.
Justification	There is need to promote early maturing and heat and cold tolerant cabbage varieties that are tolerant to black rot disease.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoALFC/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied Research to release improved cabbage varieties • Development of agronomic practices for cabbage • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of cabbage food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new cabbage varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International

	Organizations such as World Vegetables Centre, AVDRC, to provide variety, seed and production information • Private Seed Companies for quality seed multiplication (Sygenta, Seed co, Amiran, Simlaw, Kenya Seed Company , East Africa Seed, Continental Seed company • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Cabbage e.g. Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua county
Counties where TIMP will be upscaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in dissemination	• Labour intensity in planting, weeding, harvesting • Unorganized marketing channels • Limited processing technologies and consumption diversity at the household level • Limited seed systems hinder farmers from obtaining seed for new varieties • Unavailability of quality seed and high seed cost • Limited access to rural finance for pulse production • Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties • Information dissemination on production practices • Promotion of the variety in the suitable areas • Mechanize cabbage production • Promote marketing models that encourage collective production and marketing • Develop good policy for the cabbage crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems • Available varieties not tolerant to heat stress which is a constraint in the new target areas
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • Partnership is important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary for	• Creation of awareness on nutritional value of cabbage • Harmonious gender consideration in research, consumption and marketing.

development and up scaling	• It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time such as implementation of the flour blending policy. • Re-establish linkage between cabbage production and consumption importance in the local diet • Use of contract management as a means to guarantee consistent supply • Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards • Provide market information on volume, quality and supply consistency requirements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of seedlings per acre (11,111/acre @ KES 2/seedling)= KES 22,222
Estimated returns	Returns per acre (16,000kg per acre @ KES 10/kg) = KES 160,000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have limited access to farm inputs than men • Women and youth may have less access to credit than men • Women and youth may have less access to labour than men • The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • 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 than men
Gender related opportunities	• The relatively steady stream of income from cabbage production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). • Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • The technology is acceptable and easy to upscale by both males and female gender • Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men

VMG related opportunities	• Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use • It is a lucrative enterprise and if involved VMGs will be availed opportunity to be gainfully engaged • Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Contact farmers in Nyandarua who participated in the initial demos are now rich with upgraded livelihood. • Increase in production from 28 t/ha to 32 t/ha
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up -scaling
G. Contacts	
Contacts	Institute Director, Food Crops Research Institute , P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, Seedco, Royal, Simlaw, Syngenta, County governments, Universities, Agricultural University Colleges,

Research Gaps

Research to release more superior cabbage varieties that are tolerant to diseases

Evaluation of more heat tolerant varieties in the different regions

2.2 CABBAGE SEED SYSTEMS

2. 2.1TIMP Name	**Cabbage formal seed system**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of a well-established seed system has hindered promotion of the crop to the target areas. Promotion of cabbage to farmers in the various counties to improve production will require enough quality seed and the weak cabbage formal seed system and mainly **relying on imports**, hence will not be able to achieve the quantities of the seed which will be required.

What is it? (TIMP description)	Formal seed system is the process of producing seed starting from release of varieties, production of early generation seed, and certified seed up to the stage where the farmers can access it through seed merchants for planting. The main stakeholders in formal seed systems include breeders, seed companies and retailers among others.
Justification  Imported seed of Pretoria F1	The selection of quality and high yielding seeds is very important in cabbage farming. The success of the cabbage value chain in Kenya will require the establishment of a strong formal seed system and seed access channels for quality seed to reach the farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	On farm and on station research trials and demonstrations Training workshops, Seminars, Meetings Field days MoALFC/Extension officers Farmer research networks Farmer to farmer Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals) Web material's
Critical/essential factors for successful promotion	Development of good seed systems to backstop own seed selection Seed availability and accessibility through cabbage research Well organized farmer groups and networks County and central government support Funding to research, validate and promote new cabbage varieties and seed production
Partners/stakeholders for scaling up and their roles	KALRO, National Agricultural Research Institutes (NARIs) seed companies and International research organizations to provide varieties, seed and production information Seed companies for quality seed multiplication Market players to create a demand and pull production Farmers/farmer groups to adopt and produce County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination NGOs to take up cabbage e.g. Farm Africa for farmer organizing and mobilization Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already	Nyandarua, Kiambu, Nyeri, Meru,Kisii and Kericho

promoted if any	
Counties where TIMP will be up scaled	West-Pokot,Taita taveta and Uasin Gishu
Challenges in dissemination	Unwillingness of farmers to buy quality seeds Poor distribution of quality seed Wide scope of production areas Low use of agronomic practices
Suggestions for addressing the challenges	Train farmers on their ability to access seed Research to develop high yielding superior varieties with superior qualities Information dissemination on importance of using good seed to increase yield Involve County governments, extension, Agrovet and seed companies
Lessons learned in up scaling if any	Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. Harmonious gender and social consideration in research, consumption and marketing. It is an already "a climate change ready crop" due to its wide adaptation ability. Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Rely on importation
Estimated returns	Rely on importation
Gender issues and concerns in development ,dissemination, adoption and scaling up	Labour intensity in planting, weeding, which are mostly done by women and youth Women may have less access to financial resources required to purchase quality seed In some areas, slow information and awareness flow to female farmers due to high illiteracy levels Women may not be able to reach far way markets or have bargaining power
Gender related opportunities	Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. The technology is acceptable and easy to upscale by both males and female gender Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to land for cabbage cultivation than men VMGs may also have limited access to finances to buy the required inputs such as seeds than men Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Cabbage is nutritious and has antioxidant properties which would be beneficial especially to health challenged groups if engaged in growing and use It is a lucrative enterprise and if involved VMGs will be availed

	opportunity to be gainfully engaged Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Seed companies & KALRO were able to select and release many high yielding & pest/disease resistant varieties for a long time.
Application guidelines for users	**Reference:** Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
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-Thika; E-mail: director.hri@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-Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O.,Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	

Research Gaps

There is disconnect between research and the end users on the type of varieties needed in the target areas. The solution will be working with stakeholders in technology development**.**

Research in well-organized seed production, multiplication and delivery system

2.3 FOOD SAFETY MANAGEMENT SYSTEMS

2.3.1. TIMPs name	**Good Agricultural Practice (GAP) for Cabbage**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Noncompliance with regulations and policies that are put in place to enable the production and consumption of quality and safe food/farm produce has led to declining food safety and Reduced food quality. Knowledge of Sustainable farming practices that will ensure reduced negative environmental impact, worker safety and health is required in addition to enhanced traceability process across cabbage value chain. Excessive pesticides application to cabbage using wrong application techniques are some of the areas raising a lot of concern within the production system
What is it? (TIMP description)	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. 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.
Justification	Good Agricultural Practice (GAP) is based on the principles of risk prevention, risk analysis, and sustainable agriculture (employing Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table but also upstream to include suppliers (e.g. fertilizers, plant protection) and all value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All Cabbage 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, field days, shows, farmer to farmer communication, leaflets and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support from government
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MoALFC, KEPHIS,AFA,Private extension providers and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Taita Taveta, Makueni, Meru, Uasin Gishu, Marakwet, Trans Nzoia, Bungoma, Busia, Kakemega, Vihiga, Kisumu, Kisii, Siaya
Counties where TIMP will be upscale	All counties in Kenya where Cabbage is produced and consumed
Challenges in dissemination	Inadequate knowledge dissemination on the benefits of 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 Increase legislative policy formulation and implementation of GAPs standards To create an enforcement policy that will subject all stakeholders to implement GAP standards
Lessons learned in up scaling, if any	The low uptake by stakeholders 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	Costs are dependent with certifying institutions
Estimated returns	Returns can be determined after consulting with certifying institution

Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances resources which may hinder them in adopting the GAP standards. Women and youth may have limited access to farm inputs than men The technology may not be adopted if the gender targeted is women who are especially overburdened Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic
Gender related opportunities	Proper application of GAP will led to improved health of the various gender categories such as women Use of the farmer field and business school strategy for effective training of farmer groups on cabbage production and marketing GAPs standards
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs are not given equal chances of attending the GAP trainings opportunities VMGs may also have limited access to finances to buy the different required inputs that ensures production of quality and safe foods along the cabbage value chain VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased awareness creation will increase production of quality and safe food along cabbage value chain. This will lead to increased consumption and utilization of quality and safe cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Options for certification exist depending on weather it is a single holder certification or group compliance. Compliance is a process and hence takes time and involves a process of continuous improvement. No need for farm sophistication to adopt. There is provision for taking corrective action for all noncompliance at time of assessment. Requires continuous training and exposure to better systems.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	Officer in Charge KALRO – PTC, Centre Directors; KALRO FCRI Njoro; Director General KALRO.
Lead organization and	KALRO, – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar

scientists	Kambo, Sylvia Kuria
Partner organizations and their roles	MoALFC, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.3.2. TIMP Name	**Hazard Analysis Critical Control Points (HACCP) Plan for Cabbage 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 in the cabbage value chain in Kenya have a direct effect on consumer's health thereby constantly increasing demand for high quality of the crop and it's by products from consumers and public health departments in counties. These hazards have direct economic consequences affecting families, communities and industries subsisting on the cabbage value chain in Kenya. This ultimately leads to reduced productivity of the active population in the country. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Shingella spp.,* and *Staphylococcus aureus*. The chemical hazards due to heavy metal accumulations like lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards cause neurological disorders, cancer and birth defects to the consumers in the value chain.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Cabbage 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 Cabbage supply from biological, chemical and physical hazards into the hands of food management systems. This HACCP system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls. When this HACCP concept is applied to the management of likely adverse health effects resulting from exposure to hazards in the Cabbage value chain a wholesome and safe Cabbage value chain can be maintained improving on trade and health within and without Kenya borders.
Justification	The only important tool kit to assure food safety through monitoring in the Cabbage value chain is the Hazard Analysis and Critical Control Points (HACCP) system. This critical tool is already incorporated into the Codex Alimentarius of the world as well as into the national public health food safety legislations of Kenya. The HACCP approach can be applied to all stages of the Cabbage value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the Cabbage value chain will easily be identified through critical control points. 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 required. In this Cabbage value chain, the proposed FSMS that will be

	adopted, different hazards would be minimized in every phase of production, harvesting, processing, distribution and consumption making Cabbage safe for consumption by Kenyans. Key elements will be identified that will be used or modified to reduce hazards formation in all steps of production to consumption.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage value chain actors from farmers, traders, food vendors, food processors and consumers.
Approaches used in dissemination	The entire Cabbage value chain will be evaluated by determining contamination hazards in primary production systems and available control methods. The information will be disseminated using Farmer trainings, farmer field schools, shows, trade fairs, Plant clinics, common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, and Twitter).
Critical/essential factors for successful promotion	For successful promotion of food safety management system through HACCP in the Cabbage value chain; An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the cabbage growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards will be formulated. Distribution of the printed HACCP plan to Cabbage value chain actors for implementation in order to reduce hazards.
Partners/stakeholders for scaling up and their respective roles.	Institutions with IPM and ICM programs Institutions responsible for legislating in food safety, regulations and sale of pesticides Institutions with the required analytical testing Training institutions with extension programs to producers and other actors on the chain Producers and exporters associations. County extension staff Universities (Public and Private) NGOs Private sector Processors and local traders
C: Current situation and future scaling up	
Counties where already promoted. if any	Busia, Taita Taveta, Makueni, Meru, Uasin Gishu, Marakwet, Trans Nzoia, Bungoma, Busia, Kakemega, Vihiga, Kisumu, Kisii, Siaya
Counties where TIMPs will be up scaled	All counties growing and consuming Cabbage in Kenya.
Challenges in development and dissemination	Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	Funding of dissemination platforms
Lessons learned in up scaling, if any	The value chain of cabbage in Kenya is willing to adopt the HACCP plan if well engaged.
Social, environmental, policy and market conditions necessary for	The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in cabbage value chain.

development and up-scaling	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost is dependent with the certifying institution
Estimated returns	Returns is determined by the holistic achievement of the standards and market access that conventional method are unable to access.
Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances to buy the required inputs inorder to set up structures that enhance GAPs standards adheherence Women and youth may have limited access to farm inputs than men The technology may not be adopted if the gender targeted is women who are especially overburdened Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Proper application of HACCP will lead to improved health of the various gender categories such as women All gender categories can participate in growing cabbage varieties Use of the farmer field and business school strategy for effective training of farmer groups on cabbage production and marketing Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. Opportunities for youths and women exists in cabbage production and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled VMGs have limited access to land for cabbage cultivation than men VMGs may have less access to credit VMGs have less access to agricultural information, technology and knowledge than men High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	Affirmative action in the provision of finances to VMGs Increased production will lead to increased consumption and utilization of cabbage s hence improved health of VMGs
○ **E: Case studies/profiles of success stories**	
Success stories	N/A
Application guidelines for users	N/A
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires	Ready for up scaling;

further research)	
○ **G: Contacts**	
Contacts	Institute Director, KALRO- Thika, P.O. Box 220 01000 Thika, Email: CD.HRI @kalro.org, Phone: 0722436544, Thika Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Esilaba A.O., Odhiambo H., Otipa M. J., Masinde A. A.O., Opondo R., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.4 AGRONOMY

2.4.1 TIMP Name	**Site selection**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Improper site/plot selection leads to abiotic factors which are among the major causes of soil factors that contribute to reduced yields and reduced quality of cabbage
What is it (TIMP description)	This is choosing suitable place/plot for growing cabbage crop. Cabbage is planted in plots based on crop rotation procedures, nature of land terrain, trees/hedges among others. This is to avoid pest and disease, water logging, shading effect among others. Use plots with soil pH of about 6.5 – 7.5 or above. The fields should be well drained to avoid diseases like dumping off, encourage good growth and ease harvesting. In addition select plots where the weed population (e.g. grasses like couch grass and nut grass) has been reduced.
Justification	Plots originally grown with brassica family crops contributes to soil pest and disease built up in the soils. Subsequently, this negatively influence crop yields. Climate change (rainfall, temperature and humidity changes) also increases buildup of pests and diseases, the disease pressure is also enhanced by the climate change. There is need to select suitable sites for cabbage production that is well soil drainage, free from diseases and pests including weeds that significantly contribute to yield reduction and increased costs of control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, researchers,
Approaches used in dissemination	•ToTs, Extension publications (leaflets, booklets, posters etc.) •FFS •Local FM Radio Stations, TV •Farmer group training •On-farm experimentation •Field days •Agricultural shows and trade fairs

	•Farmer to farmer communication •Plot demonstrations
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, functioning stakeholder networks, effective extension services
Partners/stakeholders for scaling up and their respective roles	NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMPs will be up-scaled	West Pokot and Marsabit
Challenges in dissemination	Low numbers of extension staff has led to high farmer to farmer ratio. Limited funding of extension services has also aggravated the situation. Population growth made usage of land meant for agricultural production transformed into construction purposes
Suggestion for addressing the challenges	Use of alternative extension methods/techniques like group approach mass media and ICT technologies. Need to partner with other service providers Employ new farming technologies such as hydroponic and aeroponic farming
Lessons learned In up scaling	Improved stakeholder linkages and participatory implementation is important in dissemination of technologies to end users. Site selection for the cabbage growing is key to enhancing production.
Social, environmental, policy and market conditions necessary for development and scaling	•Cabbage is a crop that widely grown in Kenya and is likely to be adopted. However, the acreage and production is low despite the region potential •The demand for the cabbage is there and increasing due to population increase •Existence of suitable bio-physical environments in target counties. •Availability of market for cabbage.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input is the cost of leasing land at suitable site with a range 5000-10000 depending on the location.
Estimated returns	Ranging from KES 250,000 to 350,000 per acre
Gender issues and concerns in development and dissemination	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. Women and youth may have limited access to farm inputs than men Women and youth may have less access to credit than men Women and youth may have less access to labour than men The technology may not be adopted if the gender targeted especially women is overburdened Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic 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 than men
Gender related opportunities	Employment opportunities for youths exists in transportation of cabbage Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. The technology is acceptable and easy to upscale by both males and female gender Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to land for cabbage cultivation than men VMGs may also have limited access to finances to buy the required inputs such as seeds than men VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar project	
Application guidelines for users	Cabbage extension training manual Ochieng V., Wasilwa L.., Kiprono C., Musembi, F. J and Wadenje J. 2015. Cabbage cultivation manual and brochures with descriptors of these varieties documented under KOPIA Project.
Status of TIMP readiness .1) Ready for up scaling; 2. Require validation; 3) Require further research R	Ready for up-scaling
G: Contacts	
Contacts	Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O.,Opondo R., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R.
Partner organizations	MoALFC, Farmers groups, County governments,

RESEARCH GAPS

Generation of data on quantification of yield reduction due to poor site selection,

2.4.2 TIMP Name	**Land preparation**
Category (i.e. technology, innovation or management	Management Practice

practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Improper land preparation due to lack of knowledge. Lack of knowledge on the available option of land preparation methods and the different land preparation implements.
What is it (TIMP description)	Soil preparation for cabbage sowing involves land clearing and tillage. Wet soil may need to be drained while dry soil may require irrigation. Tillage involves the turning of the topsoil either manually (traditionally, minimum tillage) mechanically (conventional tillage), essentially targeted at creating a favorable environment for crop establishment. Cabbages are raised from seedling or direct seeds. The crop requires relatively requires fine, flat and a smooth seedbed. Plough and harrow the land until the soil is fine, level and free from weeds. The depth of ploughing is between 30 to 40 cm. Disc and moldboard ploughs can be used in ploughing. Harrowing can be done once or twice. The number of times of field operation depends on type of soils. Ploughing is done when soil is not very wet but fairly dry. Compacted soils may require sub soiling to break the hard pans. Direct seeding requires a very fine, flat and a smooth seedbed. Proper seedbed preparation aids in controlling weeds and hence reduces competition for nutrients.
Justification	Adequate land preparation ensures increased water infiltration prevent competition from weeds that results in significant yield loses thus multiple plowing prior to sowing is also weed control measures. Given unpredictable and changing weather conditions land preparation should be timely.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, researchers,
Approaches used in dissemination	•ToTs, Extension publications (leaflets, booklets, posters etc.) •FFBS •Local FM Radio Stations, TV •Farmer group training •On-farm experimentation •Field days •Agricultural shows and trade fairs •Farmer to farmer communication •Plot demonstrations, small seed packets
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, functioning stakeholder networks, effective extension services
Partners/stakeholders for scaling up and their respective roles	NGOs, extension, private service providers, Universities, agricultural machinery manufacturers, distributors and fabricators
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMPs will be up-scaled	West Pokot and Marsabit counties
Challenges in dissemination	Non adoption of good land preparation is attributed to high cost of fuel and mechanize operation.

Suggestion for addressing the challenges	Use of conservation tillage like minimum and zero tillage to minimize tillage
Lessons learned In up scaling	Poor land preparation may lead to low cabbage yields. This demands training of farmers. An Investments in the crop and participation of ploughing contest can enhance technology up-take – like the case of this technology in stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary for development and scaling	•Cabbage is socially acceptable in the targeted counties and any technology to increase its production will be readily adopted. •Awareness of the benefits/advantages/management of the technology to enhance adoption and commercialization for increased up take. •Existence of suitable bio-physical environments in target counties. •Availability of market for the commodity.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is for land preparation. The cost will vary from KES 8000 to 12500 per acre;
Estimated returns	The estimated returns is about KES 350,000 per acre with a return of about KES 40 per shilling invested in land preparation
Gender issues and concerns in development and dissemination	Women and youth have limited access to land for cabbage cultivation than men Women and youth may have limited access to farm inputs than men Women and youth may have less access to labour than men The technology may not be adopted if the gender targeted especially women is overburdened Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic 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 than men
Gender related opportunities	Employment opportunities for youths exists in land preparation and transportation of cabbage Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. The technology is acceptable and easy to upscale by both males and female gender Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to land for cabbage cultivation than men VMGs may also have limited access to finances to buy the required inputs such as seeds than men VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar project	Consecration tillage has given good results in terms reducing costs and increasing crop yields.
Application guidelines for users	Cabbage extension training manual
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research R	Ready for up-scaling
G: Contacts	
Contacts	Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R.
Partner organizations	MoALFC, County governments, Universities, Agricultural University Colleges and local NGOs

RESEARCH GAPS

Generation of data on quantification of yield reduction due to improper land preparation

Relative advantage of different methods and different regimes of land preparation

2.4.3 TIMP Name	**Planting/transplanting cabbage**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Under size heads and low yield due to poor method of planting which results in competition between seedlings for water, nutrients and sunlight energy.
What is it? (TIMP description)  Seedlings raised on trays in soilless media	Seeds/seedlings of cabbage is planted by direct sowing in well-prepared field plots or transplant seedlings from nursery. Direct seed-sowing is achieved by planting in holes. This can be manually or mechanically done. Plant cabbages based on the crop calendar in your region if you depend on rain fed. However use of green house and irrigation technology can be harnessed and planting done at any period of the years. Cabbage can be planted using direct sowing or use seedlings rained in nurseries. ***Direct planting*** The direct planting seed rate is about 100-120 g per acre. Direct planning has a higher seed rate compared to transplanting ***Nursery raising*** Seedbed is prepared approximately 5-15 cm high and 1.0 m wide. In the seed apply a small layer of compost on the seedbed before mulching. In a square meter seedbed, incorporate 40 g ammonium sulfate, 50 g super phosphate, 30 g potassium chloride, and 2 kg/compost. Commercial inorganic fertilizer could be skipped for organic farming. Ask assistance from the local agriculturist office for advice in growing organic cabbage and in order to maintain and supply the nutrient requirement of the plant. The bed is protect with a net or shed to prevent the seedlings from early pest

 Seedlings raised on benches in a greenhouse  Transplanting, watering and mulching	infestation, heavy rain, and direct sunlight. Post commercial inorganic fertilizer could be skipped for organic farming. Planting can be done in sunken or raised beds with a height of least 30 to 40 cm high. High raised beds have many agronomic advantages: better drainage, better aeration, and the soil is loose allowing roots to explore better. Cultural advantages include application of contact herbicides, planting, clearing by hand, mechanical clearing, fumigation, crop sampling and harvest. Planting cabbage in rows spaced at 60 cm x 45-60 cm inter and intra-row spacing, respectively depending on variety/cabbage head size can also be used depending on the potential head size. It is recommended that 26000 – 30 000 plants/ha is planted for the loose head market. Higher plant populations raise the average yield per hectare, but the heads are smaller. For the bagging or chain-store / pre-pack market a density of 35- 45 000 plants/ ha is recommended. However, it must be noted that the population of a cabbage field per hectare for a commercial grower can vary and planting is dependent on what the specific market needs and available resources are.
Justification	Planting is a basis for a good stand for optimal yields in the ever changing climatic conditions. Correct seed rate and spacing give optimal yields. The spacing, reduces competition between seedlings for nutrients, water and sunlight. Correct spacing translates into increase yield and ensures lower seed cost. The potential of reduced seed rate technologies is to reduce problem of lodging and weak stems that cannot support the weight of filled head of grain. Reduced seed rate enhance productivity due to reduced competition for limited water resources, light and nutrients.
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMP will be up-scaled	Marsabit &West Pokot
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, researchers, CBOs, NGOs
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, TOT training
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
Partners/stakeholders for scaling up	MoALFC, Egerton university, NGOs e.g. FIPs (Farmer Input Promotion), CBOs, Farmer Groups, Service provider agencies
C: Current situation and future scaling up	
County where Timp has been promoted (if any)	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
County where Timp will be upscale	Marsabit and West Pokot
Challenges in dissemination	Labour intensive for small holder farmers and planting demands high costs Time consuming; manual planting in rows is slow and takes quite a lot of

	time; Its expensive most smallholder farmers cannot afford;
Recommendations for addressing the challenges	Promotion of simple and cheap mechanization equipment's for planting Farmers to form group and working together as it has been in the past (the Harambee spirit) Government to subsidies price of farm equipment's Enhanced credit for farmers
Lessons learned	Proper and correct spacing give optimal plant population per acres and results in high cabbage yields
Social, environmental, policy and market conditions necessary	Women are key players in cabbage planting
D**: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	The cost of planting ranges from KES 5000 to8000per acre
Estimated returns	The investor gets returns of about KES 90 for every shilling invested in planting
Gender issues and concerns in development and dissemination	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. Women and youth may have limited access to farm inputs than men Women and youth may have less access to credit than men Women and youth may have less access to labour than men The technology may not be adopted if the gender targeted especially women is overburdened Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic 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 than men
Gender related opportunities	Employment opportunities for youths exists in transportation of cabbage Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. The technology is acceptable and easy to upscale by both males and female gender Opportunities for youths and women exists in cabbages production , and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to land for cabbage cultivation than men VMGs may also have limited access to finances to buy the required inputs such as seeds than men VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs

E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Manual, leaflets posters and Brochures can be used
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts M	
Contacts	. Institute Director, KALRO- Thika, P.O. Box 220 01000 Thika, . Email: CD.HRI @kalro.org, Phone: 0722436544, Thika . . Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC in Counties

RESEARCH GAPS

1. Generation of data comparing different planting methods across the popular grown varieties,

2.4.4 TIMP Name	Fertilizer application
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield due to poor method of suboptimal fertilizer application
What is it? (TIMP description)	Fertilizers are chemical (inorganic) or organic materials containing plant nutrients, which are added to the soil to supplement its natural fertility or replenish lost fertility Before applying fertilizers soil testing should done. After soil testing one will be able to apply the right among and type of fertilizers. The general fertilizer recommendation: 100-150 kg/ha N: 50-65 kg/ha P: 100-130 kg/ha K. Split the recommended fertilizer amount into 3 and apply it as basal, 3 weeks after transplanting, and during heading. Apart from calcium ammonium nitrate (CAN), urea), phosphorus fertilizers (primarily supply phosphorus; single superphosphate (SSP), triple superphosphate (TSP), and natural rock phosphate, foliar fertilizers can be used. In addition, during land preparation, incorporate 10-20 tons of manure/ha.
Justification	Over years cabbage yield has declined due to declining soil fertility because of nutrient mining. Due to nutrient mining through cabbage harvests, there is need to apply nutrients from external sources. The potential of reduced fertilizer rate reduce reduces yields. Correct fertilizer reduces cost of fertilizer/manure and subsequently increasing profits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, researchers, CBOs, NGOs
Approaches used in	FFBS., Demonstrations, farmers field and business schools and exhibition

developments dissemination	exchange educational tour, ToT, extension publication e.g. brochures, leaflets, posters
Most effective approach	FFBS
Critical/essential factors for successful promotion	Use of multiple methods in dissemination of fertilizer technologies Create awareness among farmers and youth groups Promoting the crop during chief barazas & meetings Rapid campaign and lobbying through extension by influencing the eating habit of some pastoral communities Training women and men groups on important role of cabbage especially as resilient crop during this climate change phenomena and cabbage health nutritional benefits. It also earns income generation
Partners/stakeholders for scaling up	Farmers, Universities, County department of Agriculture, NGOS e.g. world concern FH, world vision, world food programme CBOS, research extension.
C: Current situation and future scaling up	
County where TIMP has been promoted if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
County where TIMP will be upscaled	Marsabit and West Pokot Are among the potential Counties where trial are the agro-ecological is ideal for Cabbage growth
Challenges in dissemination	Limited knowledge on the Cabbage fertilization and manuring practices. Limited support from national government county government and good national policy on special crops like Cabbage. Fertilization is mainly done manually and this requires the costly labour.
Recommendations for addressing the challenges	Improved fertilization and manuring practices through capacity building of extension staff and model farmers with emphasis on the use correct type of fertilizers will ensure efficiency and achieving high productivity;
Lessons learned	Recommended fertilizer rate will produce high yield in terms of biomass production. The use of farm machinery enhances efficiency and saves on time for proper fertilization for increased yield;
Social, environmental, policy and market conditions necessary	Capacity building of stakeholders and development of sound fertilization regime.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Fertilizer costs in the range of KES 5000 to 9000 per acre
Estimated returns	It estimated that KES 330,000 will be generated per acre per harvesting season
Gender issues and concerns in development, dissemination, adoption and scaling up	Women perform most of the fertilizer application activities therefore and this may increase their work burden Women and youth have limited access to productive resources such as land and credit. Women and youth have less access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	• Cabbage production as it is a high valued crop with relatively high returns, therefore women investment in fertilization and manuring can pay off. • Employment opportunities exist for women and youth in farm operations
VMG issues and concerns	VMGs have limited access to productive resources such as cash, land and credit

in development, dissemination, adoption and scaling up	to fund cabbage production. 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	There are opportunities for VMG to acquire fertilizer in bulk as a group to reduce costs.
E: Case studies/profiles of success stories	
F F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for Upscaling
Success stories	
Application guidelines for users	Cabbage brochures, fliers, modules and manuals are being developed;
G: Contacts	
Contacts	. Institute Director, KALRO- Thika, P.O. Box 220 01000 Thika, . Email: CD.HRI @kalro.org, Phone: 0722436544, Thika . . Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC in Counties, CBOs, NGOs, Women groups;

Research gaps

Site specific fertilizer testing (fertilizer types, rates, frequencies) for cabbage to generate site specific fertilizer recommendation for cabbage

2.4.5 TIMP Name	**Water Requirement**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of Cabbage due to climate change problem, erratic and unreliable rains
What is it? (TIMP description)  *Drip irrigation method used*	Cabbage has a **high water requirement** and needs at least **500 mm** of rainfall well during growing season distributed throughout the growing period is required. In transplanted cabbage fields, copious watering is required immediately after transplanting for initial seedling establishment on the field. Irrigation, through controlled application of water over a crop field, is required for dry planting and production of crops. Proper irrigation leads to increased yields from more plants, and higher yields from healthier plants. Over irrigation is damaging, because poor drainage causes waterlogging which results in poor crop establishment, growth and salting of farmlands. Climate change has led to unpredictable soil moisture levels. Water is the major limiting factor for crop production. Cabbage needs sufficient amount but the requirement vary with stage of growth. For example young cabbage transplants or seedlings have a lower

for cabbage	water requirement. The water requirement increases progressively as complete canopy cover and head development occurs. Therefore water daily until the plants establish fully. Cabbages are very sensitive to flooding. During rainy season, appropriate drainage canals must be in placed to drain off the excess water after a heavy rain. Irrigation must be closely monitored to ensure soil moisture remains even in the beds during the cropping period. It is particularly important in the days following transplanting when seedlings are establishing new root systems. Excessive irrigation promotes root rot and results in leaching of nutrients away from the root zone. Supplying water in equal amounts throughout the season prevents cracking of the heads. Application of soluble fertilizers as fustigation can be carried out during a normal irrigation Total water requirement is approximately 440 mm. In wet seasons, as a general guideline apply 10 to 15 mm per week for the first third to half of the growing season, and about 25 mm per week thereafter. In hot days, apply 20 to 25 mm per week for the first third to half of the growing.
Justification	If water supply is below the requirement then yield losses will be observed. This demand irrigation in case water stress is observed during the cabbage growing period.
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies
Approaches used in dissemination	Use of service providers, ToT, demonstrations, farmers tour, Radio, TV, farmer to farmer
Critical/essential factors for successful promotion	Farmers tour to knowledge from other counties in the country
Partners/stakeholders for scaling up	NGOs, extension, private service providers, Research, Universities
C: Current situation and future scaling up	
Counties where already promoted, if any	All counties but at varying levels
Counties where TIMPs can be up-scaled	Marsabit County and West Pokot
Challenges in development and dissemination	Low publicity of irrigation technology Limited support from the county government and national government Inadequate technology and research inputs
Suggestions for addressing the challenges	Enhanced publicity Enhanced support from national and county government
Lessons learned in up scaling	Availability of Cost benefit information that can attract farmers to engage into the irrigation practices
Social, environmental, policy and market conditions necessary	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Unknown

Estimated returns	It's yet to determined
Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to productive resources such as land, quality seed and credit Women and youth have less access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women and youth in in watering cabbage fields
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities exist for youth exists in watering cabbage fields sing mechanization the produce
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Cabbage brochures, fliers, modules and KCSAP manuals
F. Status of TIMP readiness: 1. Ready for up-scaling; 2. Require validation; and 3. Require further research	Ready for up-scaling
G: Contacts	
Contacts	Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
.Partner organizations	County government and local NGOS

Research Gaps

Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption. Have worked up to here

2.4.6 TIMP Name	**Pest management**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of cabbage due to poor agronomic management;
What is it? (TIMP description)	Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management in Cabbage that relies on a combination of pest/disease practices. The concept of pests and diseases is

 Agri-net technology for prevention of pest	much more than just identifying a problem and applying chemicals. For many years that is what producers have done, but current agriculture practices are forcing producers to make changes for financial reasons, market requirements or even sustainability. Introducing systems that are more competitive in all regards is the final objective. For this reason the following IPM (Integrated Pest Management) principles should be kept in mind when designing a production system. It is important to have a combination of strategies such a rotation of products, Crop rotation, biological products and cultural practices. Many times the problems of extreme dependence on the use of pesticides are made worse by inappropriate applications. Use of Agri net technology is becoming popular for control of pests and diseases
Justification	Pests and diseases cause significant yield loses if not managed when controlled. In addition the quality of the produce can be compromised and subsequently the loss of revenue. The Agri-net technology comes in handy as a safe,envirometally friendly technique of pest prevention
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Nyeri, Uasin Gishu, Elgeyo Marakwet
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies
Approaches used in dissemination	Use of service providers, ToT, demonstrations, farmers tour
Critical/essential factors for successful promotion	Farmers tour to knowledge from other counties in Kenya
Partners/stakeholders for scaling up	NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMPs can be up-scaled	Marsabit County and West Pokot
Challenges in development and dissemination	Low publicity Limited support from the county government and national government Inadequate technology and research inputs
Suggestions for addressing the challenges	Enhanced publicity Enhanced support from national and county government
Lessons learned in upscaling	Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Unknown
Estimated returns	Its yet to determined
Gender issues and concerns in development, dissemination, adoption and	Women and youth have limited access to productive resources such as land, quality seed and credit Women and youth have less access to education, training and extension

scaling up	services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for male youth in in pest management
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness on disease and pest management
VMG related opportunities	Opportunities exist for youth exists in transporting the produce
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Cabbage brochures, fliers, modules and KCSAP manuals
F. Status of TIMP readiness: 1. Ready for up scaling; 2. Require validation; and 3. Require further research	Ready for up-scaling
G: Contacts	
Contacts	. Institute Director, KALRO- Thika, P.O. Box 220 01000 Thika, . Email: CD.HRI @kalro.org, Phone: 0722436544, Thika . . Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R.
.Partner organizations	County government and local NGOS

2.4.7 TIMP Name	**Weed management**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of Cabbage due to poor weed management practices
What is it? (TIMP description)	Weed control is a very important practice in Cabbage production. Cabbage field should always be free of weeds. Weeds compete with plants for light, nutrients and space and are pest and disease hosts. Weeds can be controlled manually with hoes or by using herbicides, which is the most highly recommended method.

Justification	Poor weed management significantly reduced cabbage yields and therefore income reduction. Weeds that are more problematic to manage are nut grass and couch grass. Weeds can serve as alternate hosts to diseases and insect pests. In this way, weeds can enhance pest incidence.
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies
Approaches used in dissemination	Use of service providers, Tot, demonstrations, farmers tour
Critical/essential factors for successful promotion	Farmers tour to get knowledge from counties where Cabbage production is advanced
Partners/stakeholders for scaling up	NGOs, extension, private service providers, research
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMPs can be up-scaled	Marsabit County and West Pokot
Challenges in development and dissemination	Low publicity Semi-arid environment Limited support from the county government and national government Inadequate technology and research inputs
Suggestions for addressing the challenges	Enhanced publicity Enhanced support from national and county government
Lessons learned in upscaling	Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Weed management can cost and KES 15000 per acre
Estimated returns	Average Gross margin is about KES 330000
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 to grow cabbages Women and youth have less access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women and youth in in value addition
VMG issues and concerns in development,	VMGs have limited access to productive resources such as land, credit, and quality seed VMGs have limited access to training and extension services

dissemination, adoption and scaling up	Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities exist for youth exists in transporting the produce
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Cabbage brochures, fliers, modules and manuals for KCSAP
F. Status of TIMP readiness: 1. Ready for up scaling; 2. Require validation; and 3. Require further research	Ready for up-scaling
G: Contacts	
Contacts	. Institute Director, KALRO-Thika, P.O. Box 220 01000 Thika, Email: CD.HRI@kalro.org, Phone: 0722436544, Thika . . Institute Director, KALRO-Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO scientists: Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	County government and local NGOS

2.4.8 TIMP Name	**Crop rotation for increased yield**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of cabbage due to mono-cropping;
What is it? (TIMP description)	This is the practice of growing different kinds of crops, one at a time, in a definite sequence on the same piece of land. Crop rotation is the technique of planting crops in a different area of the cabbage plot so that no single crop will be planted in the same place two—or more—years in a row. It's a practice of growing different types of crops (or none at all) in the same area over a sequence of seasons. A basic principle of crop rotation is to avoid growing the same crop for consecutive years and principles of crop production is interchanging of tap root crops with fibrous root crops, leguminous with non-leguminous, avoidance of crop of same family follow one another to avoid pest and diseases build up. Different types of plants require different types of nutrients from the soil
Justification	Routine crop rotation allows the land to remain fertile, since not all of the same nutrients are being used each season. For example, planting a legume, such as soybeans, helps to replenish necessary nitrogen in the

	soil. Crop rotation can help to manage your soil fertility reduce soil erosion, improve your soil health and increase nutrients availability to plants.
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Nyeri, Uasin Gishu, Elgeyo Marakwet
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies
Approaches used in dissemination	Use of service providers, ToT, demonstrations, farmers tour
Critical/essential factors for successful promotion	Farmers tour to knowledge from Ethiopia
Partners/stakeholders for scaling up	NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	All counties but at varying levels
Counties where TIMPs can be up-scaled	Marsabit County
Challenges in development and dissemination	Low publicity Limited support from the county government and national government Inadequate technology and research inputs
Suggestions for addressing the challenges	Enhanced publicity Enhanced support from national and county government
Lessons learned in up-scaling	Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Unknown
Estimated returns	Its yet to determined
Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to productive resources such as land, quality seed and credit Women and youth have less access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women and youth in in marketing segment and value addition
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness

VMG related opportunities	Opportunities exist for youth exists in transporting the produce and value addition
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Cabbage brochures, fliers, modules and KCSAP manuals
F. Status of TIMP readiness: 1. Ready for up-scaling; 2. Require validation; and 3. Require further research	Ready for up-scaling
G: Contacts	
Contacts	. Institute Director, KALRO- Thika, P.O. Box 220 01000 Thika, . Email: CD.HRI @kalro.org, Phone: 0722436544, Thika . . Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R.
Partner organizations	MoALFC County governments and local NGOs

Research Gaps

Identification of the most suitable diversified crop rotations and suitable rotation crops for the brassica family.

2.4.9 TIMP Name	**Harvesting**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	High losses due to poor harvesting practices
What is it? (TIMP description) 	Pre-harvest interval is the time between the last pesticide application and harvests of the treated crop. The PHI must be adhered to for cabbages. Failure to adhere to the PHI will result in pesticide residues in the harvested produce, which will render the crop unfit for human consumption and for sale Cabbage is harvested between 65 and 115 days after the transplant depending on the variety or hybrid that was planted. When harvesting the heads should be firm, compact, have the color that is characteristic of the variety (green, red or other) and look healthy. The ideal moment to harvest is based on the pressure needed to compact the head. A cabbage head that is compact and firm can be slightly compressed with pressure from a hand. A head that is too loose or soft is not ready to be harvested while a very firm head is ready to be harvested. After the cabbage is cut, remove leaves and packaged by putting in plastic crates. Reduce mechanical damage

Mature Cabbage head ready for harvesting  *Packaging cabbage heads in a crate*	to the product during the harvest, a few external leaves should be left on the head to protect it from physical damage. Traditional collection in canvas bags is not recommended because it causes a lot of crop loss. Try to place the heads in a way that they cannot easily move inside the crates. The crates should not be too full to avoid contact between the cabbages in the bottom crate with the crates that are placed on top in order to minimize mechanical damage during transport. During the harvest, the plant should be pulled out completely including the roots to eliminate crop residue. The harvest process shown above is recommended due to break the cycle of disease and pests. A selection should take place in the field, cabbage that has damage caused by pests, diseases or mechanical damage should be rejected.
Justification	Timely and proper harvesting may lead to quality produce. In addition Post-harvest interval maintaining human health
Region promoted	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Nyeri, Uasin Gishu, Elgeyo Marakwet
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies
Approaches used in dissemination	Use of service providers, Tot, demonstrations, farmers tour
Critical/essential factors for successful promotion	Farmers tour to knowledge from other counties
Partners/stakeholders for scaling up	NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	Busia, Siaya, Kisumu, Kakemega, Tharaka Nithi, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMPs can be up-scaled	Marsabit and West Pokot County
Challenges in development and dissemination	Low publicity Limited support from the county government and national government Inadequate technology and research inputs to mechanize harvesting
Suggestions for addressing the challenges	Enhanced publicity Enhanced support from national and county government Continuous research on cabbage maturity indicators
Lessons learned in up scaling	Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	unknown
Estimated returns	Its yet to determined

Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to productive resources such as land, quality seed and credit Women and youth have less access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women and youth in in value addition
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Employment opportunities exist for women and youth in harvesting the crop
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Cabbage brochures, fliers, modules and KCSAP manuals
F. Status of TIMP readiness: 1. Ready for up-scaling; 2. Require validation; and 3. Require further research	Ready for up-scaling
G: Contacts	
Contacts	. Institute Director, KALRO Kitale, P.O. Box 450-3200 Kitale, . Email: Director.fcri@kalro.org, Phone: +254-2029632, Kitale.
Lead organization and scientists	KALRO, Masinde A. A.O., Otipa M. J., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R.
Partner organizations	County government and local NGOS

2.5 SOIL FERTILITY MANAGEMENT

2.5.1 TIMP name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	

Problem addressed	Low crop yields caused by land degradation characterized by the declining soil fertility, soil moisture stress, increased soil erosion and poor soil health. Well managed manure will supply macro and micro nutrients for enhanced crop production. GHG emissions, caused by poor manure management and handling leading Environment protection by minimizing leaching of nutrients
What is it? (TIMP description)	Manure Management is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops (and aquaculture). Manure can be in solid or liquid form, and is often mixed with crop residues and composted to enable decomposition. Proper manure management reduces emission of methane and carbon dioxide.
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 22 kg/ha for nitrogen, 2.5 kg/ha for phosphorous, and 15 kg/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 nutrients (macro and micro) 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 of providing the limiting nutrients and improving the soil health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, county government, NGOs
Approaches used in dissemination	Open and field days Exchange visits Demonstration farms
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 cereal crops
Partners/stakeholders for scaling up and their roles	County governments, Provide extension services, farmer mobilization and policy formulation ILRI, technical backstopping NGOs – micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Uasin Gishu, West Pokot, Trans Nzoia, Bungoma
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Lack of 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 plots 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	Social: Acceptability of manure as a resource for increasing agricultural productivity in pastoral communities Environment: Knowledge and awareness creation on pathogens which can be harbored in the manure leading to disease outbreaks to livestock Knowledge and awareness creation to reduce risk of propagation of invasive species when the seed is ingested by the animal and passed to crop field Contamination of water sources by leaching of nutrients Markets: Availability of markets and better prices as MM would result in increased output and quality Policy: Policies that address manure management in relation to pathogens and environment (e.g. leaching, GHG emissions)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	About 20 t ha^{-1} of well managed manure will need to be applied. This would cost approximately 40,000/=
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women and youth may also have limited access to inputs such as manures than men. • Women have less access to agricultural information, technology and
Gender related opportunities	Opportunity exist for women to access the required credit through the women enterprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • VMGs may also have limited access to finances to buy the required inputs such as manures than men. • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Increased production due to use of manure will lead to increased consumption and utilization of cabbages and hence improved health of VMGs.
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
Application	The guideline focus on the following areas:-

guidelines for users	Animal feeds: Feeding livestock with quality materials e.g. high protein concentrates will result in manures with a higher nitrogen content Livestock housing and manure collection Manure storage to preserve nutrient and avoid loses by covering to minimize losses through volatilization Timing of application for maximum utilization by the crop Installing anaerobic digestion for biogas production Regular analysis of manure to ascertain the quality Manure/Composts take a long time to cure, allow 2-3 months.
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO Secretariat
Lead organization and scientists	KALRO, Esilaba A.O., Odhiambo H., Opondo R., Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W., Ndubi J., Ndambuki, J.
Partner organizations	County government, Private Public Partnerships

Research gaps

Promote IMM complementary technology in counties that have not practiced it.

Conduct nutrient budget study on selected farms utilizing manures (including composts) in the 24 Counties.

2.5.2. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to declining soil fertility, low organic matter, poor soil structure and low available moisture due to poor water holding capacity.
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 combined to adapt practices to local conditions. It 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 systems 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. ISFM therefore aims 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, Extension officer, County government
Approaches to be 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; and • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in. • Knowledge about manure combination with modest amounts of inorganic fertilizers.
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	Uasin Gishu, West Pokot, Trans Nzoia, Bungoma
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Change of mindset in some regions/cultures that organic manures cannot be applied on crops 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.
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 in areas where

	application of ISFM is non-responsive
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	• It is labour intensive hence may not be adopted by women who are already overburdened • Women and youth have limited access to credit to purchase the required inputs such as such as fertilizers than men • Women and youth have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Opportunity exist for women to access the required credit through the women enterprise funds.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • It is labour intensive hence may not be adopted by some VMGs who are elderly. • Women and youth have limited access to credit to purchase the required inputs such as such as fertilizers than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production due to use of the TIMP will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in sorghum and millet value chains in Machakos where productivity 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, lone use of inorganic or organic materials should be avoided.
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO scientists: E. Gikonyo, C. Kibunja, A. Muriuki, D. Kamau, A. Esilaba, J. Ndufa, C. Kundu and S. Kimani Odhiambo H., Opondo R., Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W., Ndubi J., Ndambuki, J.
Partner organizations	County governments KEFRI

Research gaps

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

Testing (fertilizer types, rates, frequencies) with different value chains

2.5.3. 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 not cheap to farmers, results take long and not are reproducible. The 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 simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It requires partners involved (ICRAF, iSDA and Soil Cares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.
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 to be 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 for rapid on the spot 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 storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data and fertilizer recommendation according to crop type suitability). Availability a van to mount the equipment. 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 given that agriculture is devolved. Soil Cares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, ICRAF and iSDA tests and validates the recommendation obtained in collaboration with Soil Cares 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	-
Counties where TIMP will be up-scaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	It requires continuous updating 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 pipelines for updating existing recommendation methods.
Lessons learned in up-scaling 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 Sulphur.
Social, environmental, policy and market conditions necessary	Socially acceptable-brings income, increases food production, nutrition security and family cohesion. Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. Increased productivity will provide supply to the markets Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation. Shipping selected soil and plant materials for further testing and results verification in a certified lab.
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns and no doubt will be making agronomy great again.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling
E: Case studies/profiles of success stories	

Success stories	Has been tested used successfully by other organizations like ICRAF, Soil Cares & KESREF. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.
Application guidelines for users	A handheld scanner to testing soils and crops in the field Community soil sampling champions are identified and trained on good soil sampling procedures. Soil and crop is analyzed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and scientists	KALRO, Esilaba A.O., Odhiambo H., Opondo R., Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W., Ndubi J., Ndambuki, J.
Partner organizations	*County governments in the 24 counties,* *Soil Cares,* *ICRAF and iSDA*

Research gaps:

Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
Developing a fertilizer recommendation system with options for new blends.
Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities per farmer needs.
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.
Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country.

2.5.4 TIMP Name	**Low-Cost Composting**
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Organic wastes constitutes the highest percentage of waste flow in Kenya leading to big landfills especially near the urban centres. However, there is low awareness on appropriate low cost composting technologies and lack of supporting policies. Moreover, lack of proper composting management and handling leads to increased GHG emissions.
What is it? (TIMP description)	Composting is the biological decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms under controlled aerobic conditions resulting in an accumulation of partially decayed organic matter called humus. Composting is thus one of the most effective process for recycling organic wastes intended for use in agriculture
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are being depleted at annual rate of 22 kg/ha for nitrogen, 2.5 kg/ha for phosphorus, and 15 kg/ha

	for potassium. Compost contain the nutrients nitrogen, phosphorus and potassium and that are found in most chemical fertilizer and even secondary and trace elements (such as zinc, iron and magnesium) that are not, and which are useful to the roots of growing plants. The compost also adds balanced nutrients to soil in an easily assimilated form, and helps improving soil structure by lightening heavy clays and improving water retention properties in porous sands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches used in dissemination	Open and field days Exchange visits Demonstration farms Mass and social media
Critical/essential factors for successful promotion	Training on different composting techniques and use Dissemination approach used to reach target farmers Model demonstration plots using cereal 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 ILRI - technical backstopping NGOs – micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Nyeri, Bomet, Uasin Gishu, Kakemega, Busia, Machakos
Counties where TIMP will be promoted	All 24 KSAP counties
Challenges in dissemination	Lack of model demonstration farms Lack of continuity in training of extension and farmers in composting skill Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	Establishment of many demonstration plots by counties Capacity building of smallholder farmers on composting 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 composts to improve soil fertility Use of composts to enhance crop productivity Skills in composting methodologies and minimizing health risks associated with composts making
Social, environmental, policy and market conditions necessary	Composting requires care when handling wastes that would normally contain heavy loads of pathogens and aim at removing non-biodegradable and hazardous waste and controlling odors and flies. Also compost pits if not well managed can also be a source of contamination by leaching of nutrients. Generally, applying composts to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. Hence socially and environmentally acceptable
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Preparation of composts require labour for building a compost heap, maintaining it and finally transporting and applying it field which take a lot of

	effort and time Using locally available composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where composting is practiced
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youth's male's employment exist in the task of composting.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	Opportunities for youth male employment exist in the task of composting.
E: Case studies/profiles of success stories	
Success stories	Farmers who use composts in quickly maturing crops have reported 3 to 5 times increased production due to improved soil health and better income
Application guidelines for users	The guidelines for users focus on the following areas:- Need to mix the compost with the soil to ensure adequate nutrition in the rooting zone. Compost storage to preserve nutrient and avoid loses. Timing of application for maximum utilization by the crop. Regular analysis of compost to ascertain the quality including contaminants like heavy metals and pathogens. Type of composts and quality that will determine the application rates. Materials that cannot be used for composts include, charcoal ashes, dog/cat manure, meat/animal fat, leaves or biomass from certain tree species that have toxic levels for microbes, e.g. eucalypts and cassia spp. Reference Karanja NK, Kwach HO, Njenga M (2005). Low cost composting training manual. Techniques based on the UN Habitat urban harvest CIP community based waste management initiative.
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 Resources, KALRO Secretariat
Lead organization and scientists	KALRO, Esilaba A.O., Odhiambo H., Opondo R., Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W., Ndubi J., Ndambuki, J.

Partner organizations	County government, NGO's

Research gaps

1 Promote composting technology in counties that have not practiced it.

2 Conduct nutrient budget study on selected farms using composts in the 24 Counties.

2.6 SOIL AND WATER MANAGEMENT

2.6.1 TIMP name	**Contour bands**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields arising from the risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus, contour bunds resemble narrow channel terraces commonly referred to as "*Fanya chini"* terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Contour bunds resemble narrow channel terraces commonly referred to as *"Fanya chini"* terraces. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. This also decreases the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas cereal crops requiring less water, such as sorghum or millet, can be planted on the ridges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension officers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Most effective approach	Model farm demonstration
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct contour bunds. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. External service providers – capacity building and access to technology

C: Current situation and future scaling up	
Counties where already promoted if any	- Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Practised extensively among households in Makueni and Machakos especially in the hilly regions
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenge(s) in development and dissemination	Increased risk of soil erosion if contours are improperly laid out Labour intensive and many farmers may find it difficult to implement at large scale Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	Farmers need to be supported with appropriate equipment for preparation of Contour for efficiency and increased output per man hour. Training youthful farmers to be champions of Contour bunds construction at the Ward level/village level. Training on site specific designs and construction of contour bunds Fast-track land registration
Lessons learned, if any	Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. Existence of well-developed self-help groups can lead to successful soil and water conservation activities. Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	Socially acceptable technology but needs awareness creation on its importance Current national policies on soil and water conservation need to be enforced at the County level Require policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined, but the main input cost is the labour for *contour* preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youths males employment exist in the task of contour bands
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men • The technology is labour intensive and may be difficult for the VMG to implement in the field

VMG related opportunities	Opportunities for youth's male's employment exist in the task of contour bands.
E: Case studies/profiles of success stories	
Success stories, if any	-
Application guidelines for users	Soil is excavated up-slope of the bund to a depth of 50 cm. Contour bunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400 to 500 m. The height of a bund should be at least 25 cm and have an approximate spacing of 1-2 m. In arid areas, the distance between bunds can be increased to 5-10 m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8 m across the slope.
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Ready for up-scaling
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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Governments, extension offices, Universities

Research gaps for further research

Develop site specific designs for construction – validation in other regions

Conduct trade off analysis (economic analysis) of contour bunds as a soil and water management technology in the various AEZs and along specific value chains

Develop low-cost mechanized tools to ease labor demands in contour construction and maintenance

2.6.2. TIMP name	***Zai* Pits**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to unreliable water to sustain a crop as a result of high seasonal rainfall variability leading to total crop failures. Decreased yields leading to food insecurity.
What is it? (TIMP description)	*Zai Pits* are small planting pits typically measuring 15-30 cm in width, 10-20 cm deep and spaced 60-80 cm. *Zai Pits h*arvests and stores water for prolonged crop use. Farmers plant seeds into the pits after filling one to three handfuls of organic material such as manure, compost, or dry plant biomass. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. *Zai Pits* technology has the potential to harvests and store rain water for prolonged crop use. This technology also contributes to improving the management of degraded lands, reducing soil erosion, vegetation loss and biodiversity as well as crop yield.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups, Agrovets and the County extension offices.
Most effective approach	Model farm demonstration
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct *Zai* pits. Availability of affordable organic matter i.e. manure, compost.
Partners/stakeholders for scaling up and their roles	County government extension services –delivery of information inputs to farmers. Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools NGOs – capacity building, policy support in soil and water conservation issues
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Limited adoption because of the costs involved
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production...
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement at large scale.
Suggestions for addressing the challenges	Farmers need to be supported with appropriate equipment for preparation of *Zai* pits for efficiency and increased output per man hour. Training youthful farmers to be champions of *Zai* pits construction at the Ward level/village level.
Lessons learned, if any	The technology has huge potential to increase farmers' resilience especially in ASALs. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it to maximize yields.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *Zai pit* preparation. It is estimated at KES 40 to 100 per *Zai Pit*. One acre will contain 16,000zai pits measuring 0.3x2m at depth of 15 cm. Average cost of the Zai pits would be 100*16,000= 160,000/=
Estimated returns	To be determined

Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Opportunities for youth male employment exist in the task of making Zai pits.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Opportunities for youths males employment exist in the task of making Zai pits
E: Case studies/profiles of success stories	
Success stories, if any	Two women groups in Kilifi, Matungulu sub-County of Machakos County through a representative Janet Ndunge reported having started using the *Zai pit* farming technology in 2013 after attending a farming workshop by the Institute for Culture and Ecology (ICE). "Ever since we started using *Zai pits*, we have seen an increase in our harvests as compared to the conventional methods of farming," she said. Farmers in Kathonzweni, Makueni County increased dug pits from 170 to 500 pits for crop production due to initially observed benefits. Communities in ASALs have also rehabilitated degraded lands and increased production by many folds.
Application guidelines for users	Zai pits are 5-15 cm deep, 15-50 cm wide and 80-100 cm apart. In dry areas the size of planting pits can be enlarged. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits. The Zai pits are during the dry season when labour constraints are minimal. Each pit is 20-30 cm wide, 10-30 cm deep, with the soil from the pit thrown downhill to form a crescent shaped dam. The spacing of the pits within a row, as well as the space between the rows of pits varies between 60 and 100 cm. At the beginning of the rains, 200-600 g of dung or compost (two handfuls of organic matter are approximately 300 g) are added to the pits. The organic matter is mixed, in the bottom of the hole, with approximately 5 cm soil. Each pit is then sown with 8-12 millet or sorghum seeds.
F: Status of TIMP readiness (Ready for up scaling, Requires validation; Requires further research)	Ready for up scaling
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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Governments, extension offices.

RESEARCH GAPS

Validation of the economic viability of the technology in counties where it has never been used.

2.6.3 TIMP name	**Bench terraces**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields arising from the risk of soil erosion and increased run off; low soil water retention capacity in most soils.
What is it? (TIMP description)	Bench terraces consist of a series of beds which are more or less level running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for Semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.
Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officer
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct contour bunds. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.

Challenge(s) in development and dissemination	Increased risk of soil erosion if terraces are improperly laid out Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour. Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level. Training on site specific designs and construction of bench terraces Fast track land registration
Lessons learned, if any	Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. Existence of well-developed self-help groups can lead to successful soil and water conservation activities. Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *Bench terrace* preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope
Estimated returns	The returns for cabbages grown under the TIMP are yet to be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youth's male employment exist in performing the task of bench terraces.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Application of bench terraces is expected to improve agriculture production thus, more food and income for the VMGs
E: Case studies/profiles of success stories	

Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed. But when we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new technology for their crops"
Application guidelines for users	Terraces draining in one direction should be at least 100m or more. The length can be slightly increased in arid and semi-arid regions. The width of the bench (flat part) is determined by soil depth, crop requirements, and tools to be used for cultivation. Optimum width of terrace benches ranges from 2.5 to 5 m for manually constructed ones and from 3.5 to 8 m for machine built and tractor-cultivated ones. Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 0.5% in arid or semi-arid regions to 3% in humid regions with clay soils. Maximum gradients can be 5% for reverse terraces. In high rainfall areas (more than 1000 mm annually), it is necessary to make additional drainage provisions off the terraces – although this has a risk of causing erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.
F: Status of TIMP readiness (Ready for up-scaling, Requires validation; Requires further research)	Ready for up-scaling
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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments, extension offices.

2.6.4 TIMP name	**Fanya Juu Terraces**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields arising from the risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	'Fanya juu' terraces (juu is Swahili word for 'up') are constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as Cabbage

	may then be grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off. The technology is highly suitable in low annual rainfall areas (less than 700 mm); moderate slopes (less than 20%); deep soils (more than 60 cm); and hilly areas that are subject to widespread erosion.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct contour bunds. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenge(s) in development and dissemination	Increased risk of soil erosion if terraces are improperly laid out Labour intensive and many farmers may find it difficult to implement at large scale Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	Farmers need to be supported with appropriate equipment for preparation of terraces for efficiency and increased output per man hour. Training youthful farmers to be champions of 'fanya juu' terraces construction at the Ward level/village level. Training on site specific designs and construction of 'fanya juu' terraces Fast-track land registration
Lessons learned, if any	'Fanya juu' terracing is popular due largely to the rapid benefits it gives in terms of soil and water conservation.

	Existence of well-developed self-help groups can lead to successful soil and water conservation activities. Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *terrace* preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Employment opportunities for youths male and men exist in performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men. The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	• Opportunities exist for unemployed youth in provision of labour
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in lower Eastern counties of Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runaway water and soil.
Application guidelines for users	The 'fanya juu' trench is 60 cm wide by 60 cm deep, and the bund 50 cm high by 150 cm across 19. In arid regions the trenches can be enlarged to 150 cm deep and 100 cm wide. Distance between bunds can be from 5 m on steep slopes to 20 m on gentle slopes. Stone terrace walls can be built to reinforce the bunds on very steep slopes to allow surplus water to pass between the stones without damaging the terrace. Excess water can be drained from the trenches using cut-off drains.
F: Status of TIMP readiness (Ready for	Ready for up-scaling

up-scaling, Requires validation; 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. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, M. Okoti and S. Kimani., Opondo R.
Partner organizations	County Governments, extension service, universities

2.6.5. TIMP name	**Stone lines**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to the risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description) 	Stone lines are stones placed along contour lines to slow down runoff. With time, the soil builds up on the upslope side of the stone line and a natural terrace is formed. The technology is suitable in gentle to moderate slopes (less than 10%); areas with low annual rainfall areas (200 - 750 mm); and stony areas
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Stone lines can help in the conservation of soil and moisture.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct stone lines. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer

	field schools; provide collective labor. External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Minimally practiced in hilly parts of Kakemega and Machakos
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenge(s) in development and dissemination	Increased risk of soil erosion if stone lines are improperly laid out Labour intensive and many farmers may find it difficult to implement at large scale Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	Farmers need to be supported with appropriate tools for preparation and laying of stones lines for efficiency and increased output per man hour. Training youthful farmers to be champions of laying stone lines and maintenance. Training on site specific designs and laying of stone lines Fast-track land registration
Lessons learned, if any	Existence of well-developed self-help groups can lead to successful construction of stone lines. Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For each hectare, transport and other project costs amount to around KES 25,000.
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Increased agricultural production will increase access to food and income among all gender. • Men and women will provide labour during the implementation of the technology
VMG issues and concerns in	• Limited access to information will limit access to information and adoption • Limited decision making power on land use may limit VMG in accessing

development, dissemination, adoption and scaling up	and adopting the technology • May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intensive and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	• Application of stone lines is expected to improve agriculture production thus, more food and income for the VMGs
E: Case studies/profiles of success stories	
Success stories, if any	In Burkina Faso farmers have reported doubled cereal production when stone lines are used in combination with greater use of compost as fertilizer. https://www.rural21.com/fileadmin/_migrated/content_uploads/Stone_lines_against_desertification_01.pdf
Application guidelines for users	Stone lines are built along the contours. The lines are between 0.5 and 1.5 m high, depending on the gradient of the slope. The distance between stone lines ranges from 25 to 40 m. Each hectare needs between 30 and 50 tons of stones, which are built into contour lines about 300 m long. The stone lines slow the fast-flowing rainwater, thereby reducing erosion. This allows up to 200 more litres of water to penetrate the soil per square meter. The amount of work involved is considerable: to quarry the stone, load it onto lorries and line it on the fields.
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, 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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba, S. Kimani and H. Odhiambo, R. Opondo.
Partner organizations	Government extension service.

2.6.6 TIMP name	Retention ditches
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to soil erosion and increased run off
What is it? (TIMP description) 	Retention ditches are trenches designed to catch and retain incoming runoff and hold it until it infiltrates into the ground. They can be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The technology is suitable in semi-arid areas; permeable, deep and stable soils; and on flat or gentle sloping land.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through

	farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct stone lines. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor. External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Practiced in several counties
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenge(s) in development and dissemination	Increased risk of soil erosion if retention ditches are improperly laid out Labour intensive and many farmers may find it difficult to implement at large scale Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	Farmers need to be supported with appropriate tools for digging out retention ditches for efficiency and increased output per man hour. Training youthful farmers to be champions of digging out retention ditches. Training on site specific designs and layout Fast-track land registration
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for digging retention ditches. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Increased agricultural produce will increase access to food and income

	among women, male and youth. • Youthful male and women will provide labour during the implementation of the TIMP.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Application of the TIMP is expected to improve agriculture production thus, more food and income for the VGMs.
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Eastern and Central Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of retention trenches in hillside to trap runaway water and soil.
Application guidelines for users	The ditches are dug to about 30-60 cm depth and 0.5-1 m width across the direction of the slope. In very stable soils it is possible to make the sides nearly vertical, but in most cases the top width of the ditch needs to be wider than the bottom width. The soil is thrown to the lower side of the slope to prevent it falling back in and form an embankment. On flat land, ditches are spaced at about 20m and have closed ends so that all rainwater is trapped. On sloping land ditches are spaced at 10-15 m intervals and may have open ends to discharge excess water.
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, 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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba and H Odhiambo, R.Opondo.
Partner organizations	Government extension service.

2.6.7 TIMP name	**Grass strips**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to soil erosion and increased run off
What is it? (TIMP description)	Grass strips are dense strips of grass panted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively good rainfall. The technology is

	suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and high rainfall areas.
Justification	Agricultural production is threatened in many parts of the Kenya by soil moisture stress and serious soil erosion. Conservation of soil and moisture through construction of grass strips has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	Availability of labour Availability of land, apart from cropland. Farmers and extension service with skills to design and construct stone lines. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor. External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Practiced widely in many counties, especially where mixed crop-livestock production system dominates.
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenge(s) in development and dissemination	Labour intensive for maintaining and controlling grass from becoming a weed Reduced land area for crop production
Suggestions for addressing the challenges	Farmers need to be supported with appropriate tools and suitable grass varieties. Capacity building on the maintenance of grass strips. Training on site specific designs and layout
Lessons learned, if any	Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year. Grass strips can be very appropriate for farmers who cut and carry fodder for their animals. Grasses are also used as mulch for crops by farmers.
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed and also type of grass
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limited ownership of or access to land may limit women from technology implementation • Limited power in making decisions on land use may limit women in technology adoption • The technology is labour intensive and may limit implementation by women • Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up. Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women
Gender related opportunities	• Potential to create employment for youth through provision of the labour required increased agricultural production will increase access to food and income among all gender. Youthful male and women will provide labour during the implementation of the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to information will limit access to information and adoption • Limited decision making powers on land use may limit VMG in accessing and adopting the technology • May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intense and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to Enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	Utilization of grass strips is expected to improve agricultureal production thus more food and income for the VMGs
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Kenya are recording a yield increases and reduced soil erosion after embracing grass strips. The strips also offer fodder for livestock thus enhanced feed at household levels. The fodder is sometimes sold thus earning extra income.
Application guidelines for users	Spacing between grass strips depends on the slope of the land. It can be 20-30 m on gentle slopes and 10-15m on steep land. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. The grass needs to be trimmed regularly, to prevent shading and spreading to crop areas. Various grass species are used, e.g., Vetiver, Napier, Guinea and Guatemala depending on what is locally available. Vetiver grass is drought resistant and good for reducing erosion.

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, 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; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba, S. Kimani and H. Odhiambo, Opondo..
Partner organizations	Government extension service.

2.6.8 TIMP name	**Tied ridges /Ridging /Earthing**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to water stresses, caused by erosion.
What is it? (TIMP description) 	Tied ridges are small earthen ridges, 30 cm high, with an upslope furrow which accommodates water between the ridges. Technology consist of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones. Water is applied to the top end of each furrow and flows down the crop field under the influence of gravity.
Justification	With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges helps conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.
Region promoted	Tana River, Garissa, and West Pokot counties
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Demonstrations; Farmer field schools
Critical/essential factors for successful promotion	Proximity to water sources - close to permanent water sources Suitable topography of area (level land) Technical capacity for maintenance
Partners/stakeholders for scaling up and their roles	County government – capacity building Private sector – access to credit, capacity building NGOs (Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM) – capacity building, credit facilities, facilitate technology access National Irrigation Board – technology access and capacity building Water Resources Management Authority – Water resources use management
C: Current situation and future scaling up	

Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Practised in many regions with soil moisture deficit or low rainfall levels
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Can be labour intensive during establishment phase Poor management may lead to water use inefficiencies Limited access to credit may limit uptake Land tenure insecurity in some counties limits adoption and investments
Recommendations for addressing the challenges	Enhancing farmers' capacity to see benefits Enhance access to credit Implement policy on land use and tenure
Lessons learned	Use of tied ridges with furrow irrigation significantly increases yields Poor management and designs may often result in flooding of low areas Assessment of soil erosion and sediment is key to sustainability
Social, environmental, policy and market conditions necessary	Social: Create awareness on the importance of soil and water conservation Avail low-cost technologies/equipment for soil and water conservation structures establishment Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level to reduce land degradation and improve crop yields Policies: Policies that support individual land tenure systems, and small hand driven motorized equipment will promote implementation of soil and water management TIMPs Markets: Markets for produce generated through use of tied ridges and other water conservation TIMPs will be available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not known
Estimated returns	Not known
Gender issues and concerns in development, dissemination, adoption and scaling up	Being labour intensive, there is likelihood for male dominance hence development prototypes benefit specific gender
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cabbage cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for women and youth to increase income through application of technology in production of specific value chains that favor them
VMG issues and concerns in development and	• VMGs have limited access to land for cabbage cultivation than men

dissemination	• Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	• VMGs can make business arising from the increased yields from furrow fields.
E: Case studies/profiles of success stories	
Success stories	There are successful models for such technology i.e. Mwea and Perkerra irrigation schemes where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	Sijali I V. Drip irrigation: options for smallholder farmers in Eastern and southern Africa. 2001. RELMA Technical Handbook Series 24. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency, (Sida). 60 p. + x p.; includes bibliography FAO CSA Manual FAO Irrigation Water Management: Irrigation Manual MoALFC: Training Manual for Water Users Association and farmers
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO Secretariat
Lead organization and scientists	KALRO; J. Mwaura, I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority

RESEARCH GAPS

The economic viability of the technology in different agro ecological zones need to be done

2.6.9 TIMP name	**Rain water harvesting systems (Ponds and Dams)**
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)	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 runoff). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is 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 runoff and increases yields with the additional water.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralist
Approaches to be 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	Most counties are investing on water harvesting technology at community level. More is required to increase uptake by farmers in ASALs.
Counties where TIMP will be up-scaled	ASAL counties; Tana River, Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Cabbage production., Garissa, Mandera and Wajir
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 mobilization policy for water related activities Lack of suitable training programs 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 in up-scaling, 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	Not determined Not affordable to most rural households.
Estimated returns	Time saved fetching water from afar is channeled 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 technology will save time used by women in fetching water therefore allowing them to perform other productive activities • Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to buy the required materials for implementation of the technology • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Employment opportunity exist for youth during implementation of the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • VMGs may also have limited access to finances to buy the required the required materials for implementation of the technology. • Women have less access to agricultural information, technology and knowledge than men. • The technology will reduce the time used in fetching water by the VMGs.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Employment opportunity exist for youth during implementation of the TIMP.
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 meters 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	Handbook on Rainwater Harvesting and Storage Options Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO Secretariat
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPP

Research Gap

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

2.6.10. TIMP name	Conservation Agriculture (CA)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed:	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	Conservation agriculture is management practice which maximizes on saving water on the farming by adhering to specific principles that govern it. The practices that make up this approach follow key principles that target to conserve the soil, soil moisture, and soil-nutrients, and stabilize land production while reducing production costs. Conservation agriculture principles are: 1. Minimal soil disturbance, 2. Permanent ground cover - maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), 3. Crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes
Justification	Land productivity is decreasing leading to decreased yield. Continuous land operation continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to: Enhance management of soil fertility and organic matter, and improvement of the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer. Rotations and crop associations that include legumes are capable of hosting nitrogen-fixing bacteria in their roots; this contributes to optimum plant growth without increased GHG emissions induced by fertilizer production Avoidance of tillage minimizes occurrence of net losses of carbon dioxide by microbial respiration and oxidation of the soil organic matter and builds soil structure and bio pores through soil biota and roots

	The protective soil cover of leaves, stems and stalks from the previous crop shields the soil surface from heat, wind and rain, keeps the soil cooler and reduces moisture losses by evaporation Helps to reduce soil compaction and plough pans and regenerates degraded lands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	Agricultural shows, Mass media, Chief's Baraza, Exhibitions, Farmer field Schools (FFS), On-farm and on-station demonstrations, Field Days, Extension Officers
Critical/essential factors for successful promotion	Training on principles and benefits of CA Model demonstration using crops
Partners/stakeholders for scaling up, their roles and stage of involvement	County Extension officers - Dissemination of information, capacity building NGO's (African Conservation Network, One Acre Fund)- Capacity Building, Dissemination of information CIAT, FAO – capacity building County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega
Counties where TIMP will be up-scaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Non-availability of crop residue in suitable quantities Competition for crop residues with other uses like wood fuel and livestock Land tenure (farmers reluctant to invest in CA where they do not have clear land rights) Limited knowledge on the incremental benefits of CA Limited access to CA implements
Suggestions for addressing the challenges	Enhance Public Private Partnerships (PPP) to support increased production and market access Improve KALRO and County government capacity to train and re-tool technical team so as to enhance uptake of the technology Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA with agroforestry
Lessons learned in up-scaling if any	Uptake of CA technology increases with the realized incremental benefits over time Continuous capacity building increases CA technology uptake
Social, environmental, policy and market conditions necessary for development and dissemination	Develop Integrated Herbicide Management Plan – pre-emergence and post-emergence herbicides Reliable technology adoption and suitable price and market access for produce under CA Continuous capacity building of the community on the benefits of CA technology County policies that support households investing in CA with inputs like implements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase

Estimated returns	Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation Returns on conserving soil exceeding 150 ton/hectare annually and associated increased productivity
Gender issues and concerns in development ,dissemination, adoption and scaling up	The technology may reduce women work burden when it comes to weeding hence can easily be adopted by then Reduces labor demands across all gender the gender categories hence can highly be adopted Women and youth have limited access to land for cabbage cultivation than men Women and youth may have less access to credit for dam construction than men Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• CA with trees is a management practice that that can be easily adopted by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• The technology may reduce VMGs work burden when it comes to weeding. • VMGs have less access to agricultural information, technology and knowledge than men. • VMGs have limited access to land for cabbage cultivation than men. • CA with trees is a management practice that that can be easily adopted by VMGs.
VMG related opportunities	Increased production will lead to increased consumption and utilization of cabbage s hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	**References** Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya. Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO Secretariat
Lead organization and scientists	KALRO, E. Mutuma
Partner organizations	County government, Private Public Partnerships

Research Gaps

Identification of the most suitable diversified crop rotations and suitable crops for biomass for the different counties.

Development of suitable CA implements/field equipment prototypes.

Capacity building on the benefits and operationalization of Conservation Agriculture systems – both among extension and technical staff, and at decision-making levels:

2.6.11 TIMP name	Cabbage-legume intercropping
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Decreased yields, hence low farm returns Declining soil fertility, hence soil degradation Soil erosion problems - runoff are minimized Weeds infestation – manage using increased soil cover crops Vulnerability to crop pests - practice helps slow the proliferation of pests and protect yields
What is it? (TIMP description)	Intercropping is a multiple cropping practice involving growing two or more crops in together. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change. **Single row intercropping:** involves the component sorghum and the legume arranged in alternate single rows. Spacing. The space between the two sorghum rows is 120cm and the legume is planted in between so that between legume and sorghum row is 60 cm. **Strip intercropping:** multiple rows, or a strip, of the legume is alternated with single or several rows of Cabbage... Spacing. The inter row spacing between legume is 45-60 cm and legume to Cabbage is 60 cm. The space between two Cabbage rows is 60 cm. **Control of pest through intercropping** **Push-pull cropping,** this is a mixture of trap cropping and repellent intercropping. An attractant crop attracts the pest and a repellent crop is also used to repel the pest away. **Trap cropping,** this involves planting a crop nearby that is more attractive for pests compared to the production crop, the pests will target this crop and not the production crop. **Repellent intercrops,** an intercrop that has a repellent effect to certain pests can be used. This system involved the repellent crop masking the smell of the production crop in order to keep pests away from it.
Justification	Climate change is negatively impacting agricultural productions. Farmers are experiencing low yields, crop failures, declined soil fertility and generally low farm returns from their investments. Intercropping is one of the potential management practice of enhancing climate change adaptation. It offers the potential to increase yield, enhance soil fertility/biodiversity and minimize the effects of climate change. The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single-crop environment.

	The practice have several advantages. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Secondly, crop mixtures frequently have lower pest densities, especially of insect pests. This occurs both because the mixture confuses the insects and, if chosen carefully attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and wide range of users
Approaches to be used in dissemination	Demonstrations, Agricultural shows and Extension services
Critical/essential factors for successful promotion	Awareness creation on the benefits and contribution of the practice to all stakeholders. Easy access of legume varieties that are compatible with potatoes Technical packages describing appropriate schedules of planting intercrop. Package on fertilizer rates and regimes under the practice.
Partners/stakeholders for scaling up and their roles	County governments – to provide extension services, farmer mobilization and policy formulation NGOs – to provide support on capacity building and micro-financing services
C: Current situation and future scaling up	
Counties where already promoted	Most counties in the medium to high rainfall areas & arid and semi-arid areas
Counties where TIMP will be up-scaled	All the Cabbage KCSAP Counties that will include Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Cabbage production., Garissa, Mandera and Wajir
Challenges in dissemination	Limited access and wide distribution of clean planting materials (intercrop varieties) Inadequate access of technical materials on the establishment, operations and management of intercrop management practice by farmers The increased effects of climate change hindering adoption. Farmer high poverty levels coupled with illiteracy especially in deep rural areas of Kenya.
Suggestions for addressing the challenges	Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. Use farmer field schools and demonstrations Develop a comprehensive manual on the practice to guide the farmers during the adoption
Lessons learned in up-scaling, if any	The practice is very important in pest management. Farmers can use a trap crop to attract pests, keeping them away from the main crop. Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs The number of ecological benefits provided by this practice can also accelerate up scaling. Intercropping promotes interactions between crops and pollinators, thus supporting biodiversity and wildlife species.
Social, environmental, policy and market conditions necessary	Socially accepted by both male and female gender. The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice though technically demanding especially where the objective is to control pest through intercropping
Estimated returns	Dependent on the value chain intercrop
Gender issues and concerns in development ,dissemination, adoption and scaling up	The technology may reduce women work burden when it comes to weeding Women and youth have limited access to land for cabbage cultivation than men Women and youth may have less access to credit for dam construction than men Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Intercropping offers good opportunities for various gender categories e.g. men and women to grow diverse crops for economic gains The technology is easy for adoption by women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	Intercropping places emphasis on the importance of using available land space to grow a diversity crops thus increasing biodiversity, pest management for VMGs economic and health gains Increased production will lead to increased consumption and utilization of cabbage hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice.
Application guidelines for users	Intercropping scheme is aimed at improving the overall economics of the farm. It is for this reason any new intercropping idea should first be tested on a relatively small area for evaluations Observe careful timing of field operations (sometimes necessitating special interventions) to keep competition between the intercropped species in balance A crop mix that works well in one year may fail the next if weather favors one crop over another. A mixture of crops with different growth forms or timing of development may make cultivation and use of mulches more difficult and less effective Planting crops in alternate rows or strips greatly simplifies management and captures some of the benefits of intercropping for pest control Intercropping poses a special problem for crop rotation. This is because if plants from two families are mixed in the same bed or field, achieving a substantial time lag before replanting either of those families may be difficult Intercropping requires extra care and effort in planning and maintaining a viable crop rotation.
F: Status of TIMP readiness (Ready for up-scaling:	Requires further research

Requires validation; Requires further research	
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO Secretariat
Lead organization and scientists	KALRO, P. Ketiem, E. Mutuma, M. Okoti, , D. Kamau, A.O. Esilaba
Partner organizations	County governments, KCEP-CRAL project

Research gaps

Major information Research gaps on intercropping performances in specific areas of Kenya. For example, there hasn't been much research on optimal levels of fertilizer use for intercropping potatoes and legumes in some areas – the need for site specific validation.

Little information on the interactions of various crop intercrops especially in the arid and semi-arid areas (ASALs).

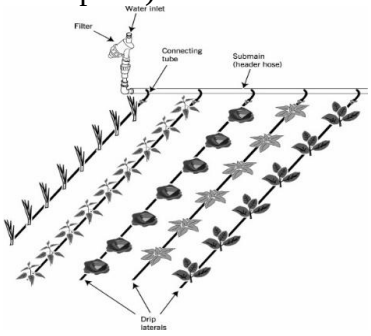
Limited knowledge on resource-use efficiency particularly in regions with impoverished soils (ASALs) and economies where measured benefits is greatest.

2.6.12 TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields: Accelerated loss of soil moisture-water stress in the soil. Suppression of weeds, loss of organic matter, managing salinity in ASALS.
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. Benefits: retain moisture in the soil; suppress weeds; keep the soil cool; 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 to be 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	County government extension services; Provide link with farmers

for scaling up and their roles	Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Current extent of reach	Available and practiced in different commodity value chains
Counties where TIMP will be promoted	All the other 17 counties which includes Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Cabbage production., Garissa, Mandera and Wajir
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.
Lessons learned	There is need to adapt to 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	Social: Create awareness to make the practice socially acceptable Environmental: TIMP users will have the knowledge about the benefits of mulch e.g. soil health improvement and control of soil erosion Markets: Increased productivity will provide supply to the markets Policies: Supporting frameworks/policies will be availed.
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 value chain but generally >100% of the initial investments.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Mulching is labour intensive hence it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted especially by women who are already overburdened. • The TIMP will reduce women's weeding time that can be used performing other productive activities.
Gender related opportunities	• The TIMP can offer employment opportunities for the youths. • The mulch is locally available on-farm.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Since the activity is labour intensive it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted. • The TIMP will reduce women's weeding time that can be used performing other productive activities.
VMG related opportunities	• The TIMP can offer employment opportunities for the youths. • The mulch is locally available on-farm.
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. However on management, pull or kill weeds that grow out of the mulch, rake the mulch occasionally to prevent it from getting packed down. This is because ccompacted mulch prevents oxygen from passing through and can starve your crop roots. Mulch should be rreplenished once a year. **Rake**
F: Status of TIMP readiness (Ready for up-scaling: Requires validation; Requires further research	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO, E. Mutuma, P. Ketiem, J. Mwaura, A. O. Esilaba, J. Wamuongo, S. Kimani and C. Kundu,R.Opondo.
Partner organizations	County governments Public-Private-Partnerships

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

2.6.13 TIMP name	**Drip irrigation systems for small scale 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	The technology that supplements water in crop production systems. 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. Mainstreaming 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
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
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
Recommendations 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	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	Social: There will be capacity building for increased awareness Policy: There will be targeted interventions to support increased investments in Drip irrigation systems Environmental: The water quality should be known to adjust the drip systems to avoid clogging and contamination
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs material 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 are available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youths have less access to credit required to install drip irrigation. Women have less access to technology and information on the TIMP. Women have less access to education, training and extension services.
Gender related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to credit required to install drip irrigation. • VMGs have less access to technology and information on the TIMP. • VMGs have less access to education, training and extension services.
VMG related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
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** 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. 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	1 =Ready for up-scaling

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; Isaya Sijali
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

Research gap

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

2.6.14 TIMP name	**Solar Irrigation for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to high cost of pumping water for irrigation, using electricity of fossil fuel powered pumps
What is it? (TIMP description)	This is the sole use of 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. With efforts in addressing climate smart agriculture focusing on renewable and green energy, solar power would be a good source of this, low cost and sustainable too
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be 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 extent of reach	Practiced 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 KSAP counties
Challenges in dissemination	• Farmers lack knowledge on the potential of solar as a power source for irrigation systems • High cost of innovation
Suggestions for addressing the challenges	Awareness training 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 depends on the energy required and size of irrigated area.
Estimated returns	Not yet done
cabbage	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances to implement and operationalize the solar irrigation system Women and youth may have less access to credit than men Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Employment opportunities exist for youth in installing the solar irrigation systems.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men. • VMGs may also have limited access to finances to implement and operationalize the solar irrigation system. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. Employment opportunities exist for youth in installing the solar irrigation systems.
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 should suit the area Use efficient water application method such as drip to avoid wastage since the water is relatively low in cost.
F: Status of TIMP readiness (1=Ready for up-scaling: 2=Requires validation; 3=Requires further research	2
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, D. Kamau,, MPO Radiro, Francis Karanja, Fabian Kaburu, P. Mwangi, and S. Kimani
Partner organizations	Solar irrigation systems suppliers County governments National Irrigation Acceleration Programme (NIAP)

Research Gaps

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

2.6.15 TIMP name	**Hydroponics technology**
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Declining farming land area, irrigation water scarcity, environmental pollution and low food crop and fodder productivity.
What is it? (TIMP description)	Hydroponic farming is soilless farming system that utilizes inert media as an anchor to the crop and a rich nutrient solution applied for the growth of the plant. There are various systems used but the most famous is the vertical hydroponic system. This utilises a small area and accommodates higher crop population than the conventional method of farming. Use of locally available soilless media such as **pumis, cocopeat** contributes into the reduction of the cost of production such as weeding, water usage, soil analysis and more.

Justification	An upward swing in Increased food demand for ever expanding population inhabiting dwindling and fragmented land sizes is the current scenario in Kenya and poised to linger on for some while. Agricultural land has been converted into real estates, commercial and industrial parks thus posing a threat to sustainable food production. Implementation of alternative and intensive farming methods becomes inevitable due to increased rural urban migration in search of white collar jobs by the youth who are more than 60% of the Kenyan population. Conventional land use is gradually becoming untenable due to escalating change of land use in high agricultural potential areas. As estimated by the year 2050, in accordance with UNHabit reports, over 80% of the Kenya's population will be residing in urban areas. Food security will become unsustainable therefore, implementation of alternative farming method that could increase output and reduce environment impacts such as soil pollution caused by high use of chemicals for crop protection is the way to go. Vertical hydroponic farming is a suitable technology in urban areas where people live in apartments and with micro-plots for farming space. Likewise, in areas that are not endowed with natural resources such as arid and semi - arid lands. Hydroponics farming system does not require herbicides and pesticides that remains in the soil causing ill-health to humans, livestock and environment. To redress these challenges, adoption of hydroponics as an alternative farming methods will greatly boost food security.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Urban and peri-urban Farmers/youth
Approaches to be used in dissemination	Capacity building workshops On-farm visits and excursions On-farm demonstrations and adaptive research trials
Critical/essential factors for successful promotion	Availability of affordable and quality local inert and clean planting media materials Take into account the farming cluster dichotomy in and around urban and peri-urban areas are earmarked for the technology adoption. Farms/ sites in terms of farming land size, labour and market availability.
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with end consumer of the technology Community leaders in case of an urban dwelling and village leaders play coordination role for ease in problem identification.
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu, Nairobi, Nakuru, Kakemega
Current extent of reach	Practiced in some value chains in the four counties above
Counties where TIMP will be promoted	Kajiado, Tharaka Nithi, Machakos, Kitui, Laikipia, Marsabit, Taita taveta
Challenges in dissemination	Labour and expertise needed Culture change of mind-set in some regions/cultures that the rich nutrient solution cannot support crops growth without soil. Initial cost implications

Suggestions for addressing the challenges	Awareness trainings on role of hydroponics in crop and fodder production. Training and awareness crop and fodder intensification on small areas and short production span Excursion training or exchange visits-- see and belief
Lessons learned if any	For hydroponics to succeed, mind-set has to change, quality of planting materials and media and the hydroponic support structurally sound.
Social, environmental, policy and market conditions necessary	Practice is socially acceptable, Environmentally friendly , since this is soilless farming Increased productivity, maximizing profits in small area. In season and out season marketing
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined. This is a technically labour friendly and low cost - Gender, vulnerable and marginalized groups
Estimated returns	To be determined. Farmers who have adopted Hydroponics technologies have realized high returns due to reduction of production and high yield in a short production cycle. But the economic costs have not been calculated
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men • Women and youth may also have limited access to finances to implement and operationalize the technology • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Employment opportunities exist for youth in installing the technology • Opportunities for youths and women exists in cabbage production and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage cultivation than men • VMGs may also have limited access to finances to implement and operationalize the technology VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased production will lead to increased consumption and utilization of cabbages and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	Hydroponics technologies successes have been reported in fodder and vegetables production in Muguga, Limuru –Kiambu county.
Application guidelines for users	Always use good quality, disease- and pest-resistant seed and planting media to ensure efficient use nutrients for vigorous growth and hence bumper production. Ensure that best bet agronomic practices are upheld For sustainability, proper structure maintenance and general management should be carried out as specified in the instructions manual

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
Lead organization and scientists	KALRO; E. Gikonyo, E. Muriuki, F. Kaburu, David Kamau,M Radiro, P. Mwangi,R.Opondo
Partner organizations	County governments Ministry of Agriculture, Livestock, Fisheries & Irrigation World Vision

Research Gaps

Validation of the hydroponics technology in Counties where technology has not been tested.
Testing with different value chains, feed and food.

2.6.16 TIMP Name	**Agroforestry for soil fertility**
Category (i.e. technology, innovation or management practice)	Complementary Technology
A: Description of the technology, innovation or management practice	
Problem addressed:	Low crop yields due to land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	It is a land use management system in which trees or shrubs grown in or among crops or pasture land for the purpose of improving soil fertility and rehabilitation of degraded lands. These systems include: • Improved fallows; Leguminous trees planted in natural fallows • Hedgerow intercropping/alley cropping; Leguminous tree species planted in hedges • Green manure; Biomass from growing leguminous plants that are cut at a certain height and ploughed back to the soil as source of manure • Mixed cropping; system of sowing two or three crops (that includes a legume) together on the same land, where one is the main crop and others are considered subsidiaries. Multi-strata; an agroforestry system whose components (crops, trees, shrubs, livestock) occupy distinct layers of the vertical structure of the community.
Justification	Given the acute poverty and limited access to mineral fertilizers in most rural farmers in Kenya, this promising approach is one that integrates organic and inorganic fertilizers. Organic fertilizers include the use of improved fallows of leguminous trees, shrubs, herbaceous legumes and biomass transfer. Continuous land operation continues to emit more GHGs (carbon) responsible for the climatic changes. Agroforestry with leguminous trees has potential to: Increase the productivity improving soil structure and protect the soil against erosion and nutrient losses by maintaining a permanent soil cover and minimizing soil disturbance.

	Conserve soil water. Enhance biodiversity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Open and field days Agricultural shows, Farmer Field Schools Mass and social media, Exchange visits Demonstration plots
Critical/essential factors for successful promotion	Training on principles and benefits of agroforestry legumes for green manure Model demonstration plots using cereal crops
Partners/stakeholders for scaling up and their roles	Governments extension services; Community mobilization and support, Supporting frameworks/policies at the local level KALRO & Kenya Forestry Research Institute (KEFRI); Implementing institutions
C: Current situation and future scaling up	
Counties where already promoted	Machakos, Siaya, Kisumu, Kakamega, Busia, Tharaka Nithi,
Current extent of reach	Few areas within the counties already promoted
Counties where the TIMP will be up-scaled	All 24 KCSAP counties
Challenges in dissemination	Limited species appropriate to different agro-ecological zones Shortage of seed Many farmers lack knowledge and skills needed to grow them Change of mindset Competing interests land tenure (farmers reluctant to invest in agroforestry technologies where they do not have clear land rights
Recommendations for addressing the challenges	Enhance Public Private Partnerships to support increased production and market access Improve county government capacity to train and re-tool technical team so as to enhance uptake of the technology Availing inputs and credit Allocation of more funds for continued research and dissemination of this technology would aid increased uptake agroforestry for soil fertility
Lessons learned	Mind sets of local farmers negative about agroforestry for soil fertility improvement. Inadequate skills in the technology and its management practices
Social, environmental, policy and market conditions necessary	Reliable technology adoption and suitable price and market access for produce grown under the improved agroforestry system
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Dependent on the technology being promoted, though minimal focusing on labour costs
Estimated returns	Returns dependent on the technology and value chain

Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for cabbage cultivation than men. • Women and youth may also have limited access to finances to implement and operationalize the technology. • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• There are opportunities for the rural women and unemployed youths in seed and seedlings sales e.g. tree nurseries
VMG issues and concerns in development and dissemination	• VMGs have limited access to land for cabbage cultivation than men. • VMGs may also have limited access to finances to implement and operationalize the technology. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG issues and concerns in adoption and scaling up	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Employment opportunities exist for youth and women raising seedlings for sales e.g. tree nurseries
VMG related opportunities	SMEs such as tree nurseries for increased resilience and income generation
Gender issues and concerns in development, dissemination, adoption and scaling up	Women have limited access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge
Gender related opportunities	The technology will reduce the time burden for women who mainly fetch water for any activity including irrigation in these ASAL communities There are opportunities for the rural women and unemployed youths in seed and seedlings sales e.g. tree nurseries
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs have limited access to credit to purchase the drip irrigation kits than men 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities exist for VMGs to venture in SMEs such as tree nurseries operators for increased resilience and income generation
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt the technology have reported increased and sustainable source of income
Application guidelines for users	Adopters of agroforestry for soil fertility will need training to decide appropriate tree species to plant
F: Status of TIMP readiness (1=Ready for up-scaling: 2=Requires validation; 3=Requires further	2

research	
G: Contacts	
Contacts	Kenya Forestry Research Institute, P.O. Box 20412, Nairobi, jkndufa@gmail.com +254 722 983238
Lead organization and scientists	KEFRI and KALRO, J. Ndufa, M. Okoti; E. Odoyo, B. Mugo
Partner organizations	County government, Private Public Partnerships

Research Gaps

Validation of existing technologies in different agro-ecological zones/counties

2.7 Cabbage Crop Health

2.7.1 Cabbage Insect pests

2.7.1.1 TIMP name	**Integrated pest management of diamond back moth *(Plutella xyllostella)* in cabbage**
	  Diamond back moth*(Plutella xyllostellla)* Source: infonet-biovision.org.
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Diamond back moth cause yield losses of between 50-80% on cabbage plant.
What is it? (TIMP description)	Integrated management of Diamond back moth in cabbage consists of various approaches that help to break the pest cycle. They include cultural, biological and chemical control. These are: **Cultural control** • Scout your crops twice per week and look out for caterpillars on the leaves of the cabbage plant. • Place seedling beds away from production fields to minimize attack by the diamondback moth. • Transplant only healthy seedlings, which are free of eggs, caterpillars and pupae of the diamondback moth and other pests. • Remove and destroy or plough down crop residues in seedling beds and production fields. • Crop rotate cabbage with crops from cereal family to disrupt pest-breeding cycle. • Intercrop chilies with cabbage to repel the pest on the farm. • Plant trap crops i.e. mustard alongside cabbage on the farm.

	• Use overhead irrigation which disrupts moth activities and washes off caterpillars from the plant. • Practice clean weeding and field hygiene within and around cabbage plantation. **Biological control** • Use of *Bacillus thuringiensis* controls outbreaks. This will help conserve natural enemies which feeds on the pest at different life stages i.e. Birds and spiders feed on moths; ants, lacewings, wasps, and parasitic wasps among others attack the caterpillars. • 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: • **CORAGEN 20SC Suspension Concentrate(Chlorantraniliprol 200g/L)** • DEBUSH 5% EC Emulsifiable Concentrate(Cypermethrin 5% w/w) • DIZON 60 EC Emulsifiable Concentrate(Diazinon 600g/L)
Justification	Diamond back moth causes total leaf damage in cabbage thus compromising the quality of the crop. Where the pest is severe and not controlled plants become greatly reduced in size and yield. Losses of above 80% 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. Currently cabbage farmers use a lot of synthetic pesticides in their control. Integrated management of pests considering food safety concerns should be highly advocated considering that the vegetable is 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, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• 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	• KES 3000 as costs for insecticides and application per acre per season; KES 1000 per acre for insect traps. KES 2,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 6,000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 50-80% of KES 250,000 (i.e. a loss of 125,000-200,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
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
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) and hand pick the diamond back moth larvae • Spraying of the crop during the diamond back moth control will create employment opportunities for young male youths
VMG issues and concerns	• VMGs have limited access to productive resources such as credit

in development, dissemination adoption and scaling up	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	• Employment opportunity exist for some VMGs such as youths in spraying.
E: Case studies/profiles of success stories	
Success stories	Biological control of DBM using Parasitoid wasp Diadegma semiclausum has proven very effective in the highlands of Kenya
Application guidelines for users	• CABI. (2004). Crop Protection Compendium, 2004 Edition. (c) CAB International Publishing. Wallingford, UK.www.cabi.org. • Cornell International Institute for Food, Agriculture and Development. Global Crop Pests. Rueda and Shelton. Diamondback moth (DBM).www.nysaes.cornell.edu. • HDRA (2000). Diamondback moth, Plutella xyllostellla. Pest Control No. TPC3. Tropical Advisory Service, HDRA, UK. www.gardenorganic.org.uk • ICIPE www.icipe.org • Oisat. Organization for Non-Chemical Pest Management in the Tropics. www.oisat.org • Shelton, A.M., Turner, A., Giga, D. Wilkinson, P., Zitzanza, E. and Utete, D. (1995). Diamondback moth. Zimbabwe Horticultural Crops Pest Management. NYSAES, Geneva NY. 2pp. • Talekar, N. S. and Shelton, A. M. (1993). Biology, Ecology and Management of Diamondback Moth. Annual Review of Entomology, Volume 38.http://web.entomology.cornell.edu.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1. Ready for up scaling.
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Centre Director** KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and	KALRO,

scientists	Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gap

1. Development of surveillance software systems for monitoring pests in cabbage fields.
2. Evaluate new cabbage varieties for tolerance to diamond back moth

2.7.1.2 TIMP name	**Integrated pest management of red spider mites *(Tetranychus spp)* in cabbage**
	 Red spider mites *(Tetranychus spp)* Source: apps.lucidcentral.org
Category (i.e. technology, innovation or management practice)	Management practise
A: Description of the technology, innovation or management practice	
Problem addressed	Red spider mites causes yield losses of up to 90% on cabbage.
What is it? (TIMP description)	Integrated management of red spider mites includes the use of various pest control strategies such as; cultural, biological and chemical control. In order to realize an effective management Programme for the red spider mites, one has to start chronologically from preventive to curative pest control measures i.e. from cultural to chemical control. The trend is such that you start with the most environmentally friendly (cultural) strategy as you move towards 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** • Scout for the pest by looking on both sides of the leaves for mite webbing: Consider action when 1 leaf per plant on average has webbing. • Place nursery away from infested cabbage or tomato fields. • Avoid transplanting next to infested fields.

	• Remove mite-hosting weeds or volunteer tomatoes. • Furrow irrigate or flood irrigate regularly to remove dust with mites (2 to 3 x per week in dry season). • Plant *Tagetes* (Marigold), lemongrass, garlic, or legumes such as *Clotolaria* (Marejea) around field to repel mites. • Avoid chemicals, as they can kill rove beetles (*Oligota*) that eat mites. • Remove and bury or burn all infested crop residues immediately after harvest as many mites live in there. • Rotate cabbage with 2 seasons of non-brassica crops, e.g. Amaranth. Do not rotate with tomatoes because they harbor mites **Biological control** • Spray max twice in two weeks interval: Red hot chili pepper soap solution; Or neem seed or leaf extract-soap mixture; Or cotton-seed-oil soap mixture in mornings reaching coverage of upper and lower surface of leaves of younger plants • Apply ash dust over moist cabbage plants in nurseries. • Smear small wooden sticks with cooking oil; place them between cabbage rows to attract ants that eat mites. • Strong water sprays and sprinkler irrigation drop mites to the ground, but can enhance cabbage diseases. **Chemical control** **Use** only pest control products recommended by Pest Control Products Board (PCPB) such as: • CLOMITE 500 SC Suspension Concentrate(Clofentezine 500g/L) • CORPION 500SC Suspension concentrate(Clofentezine 500g/L) • FOERTA 200 SC Suspension Concentrate(Fenazaquin 200g/L)
Justification	Red spider mites are a major challenge in cabbage production causing yield losses of up to 90%, and it is attributed to farmers recycling seed from previous season's crop which carry insect pests and also, farmers do not know how to manage insect pests. Presence of Integrated management options will provide farmers with a basket of management options that they can use to manage the spotted spider mites infestation on cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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

	• Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• 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	• KES 2000 as costs for insecticides and application per acre per season; KES 1000 per acre for insect traps. KES 2,000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 5,000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 90% of KES 250,000 (i.e. a loss of 225,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
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
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, 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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to cabbage red spider mites 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	• Keizer, M. and Zuurbier, J. Red Spider Mite. Namibian crop pests. • OISAT. Online Information Service for Non-Chemical Pest Management in the Tropics. www.oisat.org. • Seif, A.A., A.M. Varela, Loehr, B. and S. Michalik (2001). A Guide to IPM in French Beans Production with Emphasis on Kenya. pp. 88. ICIPE Science Press, Nairobi, Kenya. (ISBN: 92 9064 142 8). www.icipe.org. • Stoll, Gabriele (1988). Natural Crop Protection on the Tropics. AGRECOLE. C/o OKOZENTRUM, CH-4438 Langenbruck, Switzerland. • Varela, A. M., Seif, A.A., and B. Loehr (2003). A Guide to IPM in Tomato Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi, Kenya. ISBN: 92 9064 149 5. • Varela, A. M., and A.A., Seif. (2004). A Guide to IPM and Hygiene Standards in Okra Production in Kenya. ICIPE Science Press, Nairobi, Kenya ISBN: 92 9064 161 5 • Plant wise Knowledge Bank • Plantix
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi Nairobi, Kenya. **Centre Director** KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gap

1. Development of surveillance software systems for monitoring pests in cabbage fields.
2. Evaluate new cabbage varieties for tolerance to red spider mites

2.7.1.3 TIMP Name	**Integrated pest management of cutworm *(Agrotis sp.)* in Cabbage.**
	
Category (i.e. technology, innovation or management practice)	
A: Description of the techn	**t practice**
Problem addressed	cabbage.
What is it? (TIMP description)	Integrated management (IPM) of cabbage cutworms involves the use of a combination of cultural, biological and chemical control methods. These are; **Cultural Control** • Plough the land to exposes caterpillars to predators and to desiccation by the sun. • Prepare field, destroy vegetation and weeds 10 to 14 days before planting the crop in the field. • Delay planting 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 pick caterpillars at night by torch or very early morning before they return into the soil is useful at the beginning of the infestation. • Flood the field for a few days before sowing to kill cutworm caterpillars in the soil. • Bait traps consisting of flour and water and containing Btn, or other insecticides e.g. pyrethrum • Use pheromone traps, ashes and sticky substances i.e. molasses **Biological Control** • Spray neem based products like neemroc EC and Nimbecidine (Azadirachtin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). • Apply pesticides judiciously to conserve pteromalid wasps (parasitize the larvae), phytoseiid mites (feed on eggs), spiders (feed on adults) **Chemical Control**

	• Spray with Alpha Cypermethrin (Tata Alpha 10 EC-5ml/20 litres water, Lambda-cyhalothrin (Dududthrin, Rate-60ml/20L).
Justification	Cutworm cause considerable reduction in yield. Losses of above 90% are experienced due to the high pest infestation thus causing food security threat. Integrated Management of pests considering food safety concerns should be advocated considering that the most important food crop in Kenya. The IPM strategies involve the use of a combination of cultural, bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling upand their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness.

	• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up Scaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing thechallenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• 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	• KES 1500 as costs for insecticides and application per acre per season; KES 1000 per acre for insect traps. KES 1,000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 3500 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 90% of KES 250,000 (i.e. a loss of 225,000) (Depending on levels of infestation, weather

	conditions and stage at which the pest affects the crop
Gender issues and concerns development, dissemination, adoption and scaling up	• The misconception in some regions that cabbage is a women's crop whereas industrial crops belongs to men • Women and youth have limited access to productive resources such as land, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to information relating to management of cabbage cutworm • Women experience financial constraints due to limited access to credits hence might not be able to purchase inputs such as pesticides • Women have less access to agricultural information, technology and knowledge Men dominant most decisions at the household and community levels
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased yields leading to stable supply of cabbage to the markets by women and youth
VMG issues and concerns 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 yields leading to stable supply of cabbage to the markets by VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• E.T. Natwick (emeritus), UC Cooperative Extension Imperial County • S.K. Dara, UC Cooperative Extension Santa Barbara County • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates • W.J. Bentley (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier

	• W.E. Chaney (emeritus), UC Cooperative Extension Monterey County • N.C. Toscano, Entomology, UC Riverside • Plant wise Knowledge Bank
F: Status of TIMP (1. ready for up-scaling 2, Requires validation 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, Muguga)
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gap

1. Development of surveillance software systems for monitoring pests in cabbage fields.
2. Evaluate new cabbage varieties for tolerance to cutworm

2.7.1.4 TIMP name	**Integrated management of cabbage saw fly *(Athalia sjostedti)* in cabbage**
	  cabbage saw fly *(Athalia sjostedti)* Source: infonet-biovision.org
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	Cabbage saw fly causes yield losses of up to 80% on cabbage production.
What is it? (TIMP description)	Integrated management (IPM) of cabbage cutworms involves the use of a combination of cultural, biological and chemical control methods. These are; **Cultural Control** • Monitor crop twice a week for larvae/pupae occurrence by looking out for small burrows filled with silk in the soil, this is a sign of pupate presence in your field. • Deep plough land after harvest to remove any pre-pupae from overwintering and infesting crops next season. • Use trap plants such as mustard as a border around the field. • Remove wild Brassica plants in the area to reduce available host plants and spread of pests. • Crop rotate with resistant crops to reduce the potential for overwintering pupae which will generate new infestations. • When infestation levels are low, handpick larvae from infested crop and destroy. • When infestation levels are low, handpick larvae from infested crop and destroy. **Biological control** • Use of biopesticides such as *Bacillus thuringiensis* can be used to control sawfly larvae populations. **Chemical control** Use chemicals registered by pest control and produce board such as; • RUNNER 240 SC (Methoxyfenozide) and follow manufacturers recommendation. • MURCLOPRID 25 WP (Imidacloprid 250g/Kg) and follow manufacturers recommendation.
Justification	Cabbage production presents an opportunity for food security, nutrition and economic empowerment of producing communities. The timely application of preventive measures to control/management would lead to higher yields. Cabbage saw fly can cause up to 80% yield loss and hence timely application of the control measures is critical to save yields. Farmers/producers will gain healthier and higher yield for economic benefits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be upscaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• 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	• KES 3000 as costs for insecticides and application per acre per season; KES 2000 per acre for insect traps. KES 2500 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 7,500 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 80% of KES 250,000 (i.e. a loss of 200,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land, and quality seeds than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to information relating to management of cabbage sawfly • Women experience financial constraints due to limited access to credits hence might not be able to purchase inputs such as pesticides • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased yields leading to stable supply of cabbage to the markets by women and youth
VMG issues and concerns in development, dissemination adoption	• VMGs have limited access to productive resources such as land, credit, and quality seeds

and scaling up	• 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 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 yields leading to stable supply of cabbage to the markets by VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• CABI-Plantwse Knowledge Bank
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gaps

1. Validation of use of agri-nets for management of pests in cabbages.
2. Development of surveillance software systems for monitoring pests in cabbage fields.
3. Evaluate new cabbage varieties for tolerance to cabbage saw fly

2.7.1.5 TIMP name	**Integrated management of cabbage aphids *(Brevicoryne brassicae)* in cabbage.**

	 Cabbage aphids *(Brevicoryne brassicae)* Source: ag.umass.edu
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Aphid's causes yield losses of between 70-80% on cabbage crops.
What is it? (TIMP description)	Integrated control practice for cabbage soil pests involves the use of a combination of cultural, biological and chemical control methods in cabbage fields. These are: **Cultural control** • Intercrop cabbage with repellant crops such as onions and garlic • Propagate cabbage seed under insect protected environment such as greenhouse or under Agro nets • Weed the field to get rid of alternate host for aphids • Maintain a hedge around the cabbage field to conserve natural enemies and beneficial insects • Remove severely affected plants and destroy by burning • Use overhead irrigation to wash off aphids from the cabbage canopy • Use blue sticky traps at the rate of 8 traps per acre **Bio control** • Spray with neem oil 150ml/20 lts water and 100ml liquid soap/ water • Spray with Beauveria bassiana based product such as Beauvitech WP at rate 10g/20lts water and repeat sprays after 14 days **Chemical control** • Spray Acetamiprid like Aceta 20SP. Acetak Top 70 WG (5-10ml/20lts) or lambda cyhalothrin products such as Pentagon (10-15 ml/20 lts) or Deltamethrin based products such as Atom, Decis at the rate of 10-15mls/20 lts of water.
Justification	Cabbage aphid's species have increased across the country preventing potential yield of cabbage in most areas leading to yield losses of up to 80%. The use of different insecticide molecules, both of biological and soft-chemical natures have ensured no resurgence of aphid populations in most farms. IPM will ensure aphid populations are kept below economic injury levels. Like most other pests. Aphids have natural enemies such as lady beetle larva, wasps, spiders and parasitic fungi. Therefore, improving diversity, by planting wild flower strips in the cabbage fields and hedge rows, will enhance

	the population beneficial insects.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies

	• County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho.
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for cabbage production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• 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	• KES 2000 as costs for insecticides and application per acre per season; KES 2000 per acre for insect traps. KES 2000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 6000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre

	• Farmers who do not use the IPM package lose 70- 80% of KES 250,000 (i.e. a loss of 175,000-200,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to productive resources such as land, 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 cabbage aphids
Gender related opportunities	Opportunities for youths exists in spraying the crop
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 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 • 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-Plant wise Knowledge Bank
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi Nairobi, Kenya**.**

	Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gaps

1. Validation of use of agri-nets for management of pests in cabbages.
2. Development of surveillance software systems for monitoring pests in cabbage fields.
3. Evaluate new cabbage varieties for tolerance to cabbage aphids

2.7.1.6 TIMP name	**Integrated management of cabbage root maggot *(Delia radicum)* in cabbage**
	 Cabbage root maggot *(Delia radicum)* Source: extension.umaine.edu
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 crop damage by the pest is about 90%.
What is it? (TIMP description)	Integrated control practice for cabbage soil pests involves the use of a combination of cultural, biological and chemical control methods in cabbage fields. These are: **Cultural control** • Scout for the pest twice a week by pulling up affected plants and check roots and soil to confirm the presence of maggots • Avoid hardening transplants near infested fields. • Schedule irrigation carefully to allow older plants to outgrow maggot damage. • Disc under crop residues immediately after harvest; otherwise, some

	maggots can survive in residue and develop into adults. • Avoid successive planting of Brassica crops, especially those planted within one month of a previous Brassica crop. • Allow crop residue to dry and decompose completely. • Practise crop rotation with crop from non-brassica family. **Biological control** • Spray PESTHRIN 6% EC Emulsifiable Concentrate (Pyrithrin 6%) according to manufacturer's recommendations. **Chemical control** • Seed treatment using REDIGO DETER 300 FS (Prothioconazole 50g/L + Clothianidin 250g/L), PONCHO FS 600 (Clothianidin 600g/L).
Justification	Cabbage maggot feeding causes yellowing, stunting, slowed growth, and in some cases death of the plant causing yield loss of up to 90%. Total crop failure is experienced under high infestation leading to food insecurity. Currently cabbage farmers use a lot of synthetic pesticides in their control. The integrated pest management practices for cabbage maggot significantly reduces yield loss due to damage by this pest, which is a major challenge to cabbage farmers. The use of IPM methods are environmentally beneficial and generally risk-free for cabbage farmers and consumers. 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
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices

	• Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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,	• Willingness of stakeholders to participate

policy and market conditions necessary for development and up scaling	• 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	• KES 2000 as costs for insecticides and application per acre per season; KES 1000 per acre for insect traps. KES 2000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 5000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 90% of KES 250,000 (i.e. a loss of 225,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
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 cabbage leading to stable supply of cabbage to the market
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 • 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 cabbage stem maggot • There is low adoption by VMGs due lack of awareness
VMG related	• Employment for youths and those recovering from drugs exists in

opportunities	spraying the crop • Improved production for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• S.K. Dara, UC Cooperative Extension Santa Barbara County • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates. • W.J. Bentley (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier. • W.E. Chaney (emeritus), UC Cooperative Extension Monterey County • N.C. Toscano, Entomology, UC Riverside
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling (Use of insect predators).
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi, Kenya. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org.
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gaps

1. Validation of use of agri-nets for management of pests in cabbages.

2. Development of surveillance software systems for monitoring pests in cabbage fields.

3. Evaluate new cabbage varieties for tolerance to cabbage root maggot

2.7.1.7 TIMP name	Integrated pest management of cabbage loppers *(Trichoplusia ni)* in cabbage

	  Cabbage loppers *(Trichoplusia ni)* Source: en.wikipedia.org
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cabbage loppers causes yield loss of above 50% on cabbage.
What is it? (TIMP description)	Integrated control practice for cabbage loppers involves the use of a combination of cultural, biological and chemical control methods in cabbage fields. These are: **Cultural control** • Remove and destroy all the plant debris after harvest. The pupae might still be present in the plants. • Plough and harrow the field after harvest. • Clear the surrounding area of weeds, which may serve as alternative hosts for the pests. • Plant resistant cabbage cultivars from Kenya seed. • Handpick the caterpillars and egg masses. • Use fine nylon nets as row covers to protect seedlings from egg-laying moths. **Biological control** • Spray neem formulation (Azadirachtin, 1500 ppm) @ 5 ml/I or one lit/acre or 5%, Neem seed kernel extract (NSKE) on a weekly basis to avoid further infestation, to conserve larval Parasitoid (parasitic wasps). • Spray plants thoroughly with *Bacillus thuringiensis* (Bt) **Chemical control** • Spray DECIS FORTE EC (Deltamethrin 100g/L) according to manufacturer's recommendation. • Spray MERIT 150 SC (Indoxacarb 150g/L) according to manufacturer's recommendation.
Justification	Cabbage loppers, is the major constraint in cabbage production. It can lead to yield loss of above 50%. The integrated pest management practices for cabbage loppers sustainably reduces yield loss due to this pest hence enhancing food security. The application of this practices is also environmentally friendly and relatively safe to farmers and consumers of cabbage
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies

	and SMEs, Processors, Agro-input dealers
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on cabbage loppers • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of cabbage loppers • Establishment of FFBS • Mapping of cabbage loppers free zones for up and out scaling of certified cabbage seed production funding by government to promote production and distribution of certified seeds at farm level
Partners/stakeholders for scaling up and their roles	• Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I) Extension and Capacity Building • ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection • FAO (Food and Agricultural Organization)- co-sharing of resources and networking and knowledge management • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input

	Promotion) • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect pest management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho.
Counties where TIMPs will be up scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Big challenge between information availability and accessibility • Non-exposure of the end-user to cabbage loppers and its management strategies • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies
Suggestions for addressing the challenges	• Information dissemination – cabbage loppers integrated management strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Find innovations in reducing integrated management practices costs to encourage more cabbage production. • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up scaling, if any	• Adoption of FFBS effective in technology dissemination and adoption • Sensitization is necessary for people to appreciate the use of IPM in cabbage loppers 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	• 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 cabbage loppers 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	• KES 2000 as costs for insecticides and application per acre per season; KES 1000 per acre for insect traps. KES 1000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 4000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 50% of KES 250,000 (i.e. a loss of 125,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
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 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 cabbage loppers
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to improved livelihoods
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 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 (2005). Crop Protection Compendium, 2005 Edition. (c) CAB International Publishing. Wallingford, UK. www.cabi.org. • Hill, D. (1983). Agricultural insect pests of the tropics and their control. 2nd edition. Cambridge University Press. ISBN: 0-521-24638-5. • Hutchison, W.D., Hoch, H., Bolin, P.C., Hines, R.L. and Wold-Burkness, S.J. (2007). The Cabbage looper. Department of Entomology, University of Minnesota. Last Revised November, 2007. www.vegedge.umn.edu. • Kranz, J., Schumutterer, H. and Koch, W. (1977). Diseases, pests and weeds in tropical crops. Verlag Paul Parey. ISBN: 3-489-68626-8.OISAT: • Organisation for Non-Chemical Pest Management in the Tropics. www.oisat.org. • Ostermann, H. and Dreyer, M. (1995). Vegetables and grain legumes. In "The Neem tree Azadirachta indica A. Juss. And other meliaceous plants sources of unique natural products for integrated pest management, industry and other purposes". Edited by H. Schumutterer in collaboration with K. R. S. Ascher, M. B. Isman, M. Jacobson, C. M. Ketkar, W. Kraus, H. Rembolt, and R.C. Saxena. VCH. pp. 392-403. ISBN: 3-527-30054-6. • Varela, A. M., Seif, A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE www.icipe.org.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya. Centre Director KALRO Kabete,

	Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org.
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	CABI, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

Research gaps

1. Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management in cabbage
2. Validation of use of agri-nets for management of pests in cabbages.
3. Development of surveillance software systems for monitoring pests in cabbage fields.
4. Evaluate new cabbage varieties for tolerance to cabbage loppers

2.7.1.8 TIMP name	**Integrated pest management of cabbage web worm *(Hellula undalis)* in cabbage**
	 Cabbage web worm *(Hellula undalis)* Source: plantwise.org
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cabbage webworm causes yield loss of up to 80% on cabbage.
What is it? (TIMP description)	Integrated management of web worm in cabbage through the simultaneous application of a various options (cultural, biological and chemical). These are: **Cultural control** • Regular monitoring of young plants in the nursery and after transplant is important. Inspect crops for the presence of caterpillars and damage symptoms. • Use clean planting materials: transplant only healthy, vigorous insect-free seedlings. • Uproot and bury infested cabbage and kale stalks • Practice crop rotation with crops from cereal family **Biological control** • Spray the crops with *Bacillus thuringiensis* to conserve natural enemies of the cabbage webworm i.e. parasitic wasps (braconid,

	ichneumonid and chalcidoid wasps). • Spray neem formulation (Azadirachtin, 1500 ppm) @ 5 ml/I or one lit/acre or 5%, Neem seed kernel extract (NSKE) on a weekly basis to avoid further infestation **Chemical control** • Spray TRACER 480 SC (Spinosad 480g/L) according to manufacturer's recommendation. • Spray SLAYER 450 SC (Spinosad 450 g/L) according to manufacturer's recommendation. • Spray EPISODE 480 SC (Spinosad 480 g/L) according to manufacturer's recommendation.
Justification	Cabbage webworm young caterpillars mine leaves, bore stems and feed externally on the leaves, penetrating the heart of the plant destroying the terminal bud, and prevent heading because chlorotic speckled leaves thus compromising the quality of the crop. Under high infestations, the pest causes yield loss of up to 100%. Currently cabbage farmers use a lot of synthetic pesticides in control of spider mites. Integrated Management of pests considering food safety and international market concerns should be highly advocated considering that cabbage is consumed widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe, with soft synthetic pesticides recommended as a last option. 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, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on cabbage webworm • Create a platform for interaction of cabbage value chain stakeholders

	• Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of cabbage webworm • Establishment of FFBS Mapping of cabbage webworm free zones for up and out scaling of certified cabbage seed production funding by government to promote production and distribution of certified seeds at farm level
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• Sensitization is necessary for people to appreciate the use of IPM in

scaling, if any	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	• KES 2000 as costs for insecticides and application per acre per season; KES 3000 per acre for insect traps. KES 2000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 7000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 80% of KES 250,000 (i.e. a loss of 200,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
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 cabbage webworm
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to stable markets for cabbage
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	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	• Kessing, J. L. M. and Mau, R. F. L. (1992). Imported cabbage web worm. Hellula undalis (Fabricius). Crop Knowledge Master. Updated by: J.M. Diez April 2007. • CABI (2005). Crop Protection Compendium, 2005 Edition. (c) CAB International Publishing. Wallingford, UK. www.cabi.org. • Varela, A. M., Seif, A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE www.icipe.org • www.extento.hawaii.edu.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya**.** Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org.
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gaps

1. Train Extension staff as Plant Doctors and Lead farmers to assist farmers in pest and disease diagnosis and management in cabbage.
2. Validation of use of agri-nets for management of pests in cabbages.
3. Development of surveillance software systems for monitoring pests in cabbage fields
4. Evaluate new cabbage varieties for tolerance to cabbage webworm

2.7.1.9 TIMP name	**Integrated management of flea beetles *(Phyllotreta striolata)* in cabbage**
	  Flea beetles *(Phyllotreta striolata)* Source: plantwise.org
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Flea beetles causes yield losses of up to 71.4% on cabbage.
What is it? (TIMP description)	Integrated management of web worm in cabbage through the simultaneous application of a various options (cultural, biological and chemical). These are: **Cultural control** • Scout by checking seedlings and new transplants in the field for flea beetle damage twice per week until plants are well established • Remove weeds along field margins to prevent adult flea beetles from moving into the crop from weeds. • Use clean planting materials: transplant only healthy, vigorous insect-free seedlings. • Uproot and bury infested cabbage and kale stalks **Chemical control** • Spray CLICK 200 SL Soluble Concentrate according to manufacturer's recommendation. • Spray EABCL ADMIRE 70WDG (Imidacloprid 700g/kg) according to manufacturer's recommendation. • Seed treatment with AMIGO GT 275 FS Suspension Concentrate (Imidacloprid 175g/L + Thiram 100g/L) according to manufacturer's recommendation.
Justification	Cabbage flea beetles feed on the underside of leaves, creating small pits or irregularly shaped holes. High numbers of adults can kill or stunt seedlings, which can be economically damaging with losses of up to 80% on cabbage seedlings. Integrated Management of pests considering food safety and international market concerns should be highly advocated considering that cabbage is consumed widely in Kenya. This involves the use of a

	combination of cultural and bio-control and biopesticides that are relatively safe, with soft synthetic pesticides recommended as a last option. 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, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on cabbage webworm • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of flea beetles. • Establishment of FFBS Mapping of flea beetle free zones for up and out scaling of certified cabbage seed production funding by government to promote production and distribution of certified seeds at farm level
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect

	management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• KES 2000 as costs for insecticides and application per acre per season; KES 3000 per acre for insect traps. KES 2500 as labor and other costs for implementation of the rest of management practices in

	the IPM package per acre. Total basic costs; KES 7,500 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 71.4% of KES 250,000 (i.e. a loss of 178,500) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop
Gender issues and concerns in development, dissemination adoption and scaling up	• Women farmers might not be aware of the Integrated management of cabbage flea beetle management practice • 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 cabbage therefore there is need to ensure gender balance during trainings • The application of chemical to spray is usually associated with men
Gender related opportunities	• Opportunities for youths exists in spraying the crop • Increased production leading to stable markets for cabbage
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 agricultural knowledge and extension services such as integrated management of cabbage flea beetle 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	• E.T. Natwick (emeritus), UC Cooperative Extension Imperial County • S.K. Dara, UC Cooperative Extension Santa Barbara County • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates • W.J. Bentley (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier • W.E. Chaney (emeritus), UC Cooperative Extension Monterey

	County • N.C. Toscano, Entomology, UC Riverside
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org.
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gaps

1. Train Extension staff as Plant Doctors and Lead farmers to assist farmers in pest and disease diagnosis and management in cabbage.
2. Validation of use of agri-nets for management of pests in cabbages.
3. Development of surveillance software systems for monitoring pests in cabbage fields
4. Evaluate new cabbage varieties for tolerance to flea beetle

2.7.1.10 TIMP name	**Integrated management of head caterpillar *(Crocidolomia pavonana)* in cabbage**
	  Head caterpillar *(Crocidolomia pavonana)* Source: apps.lucidcentral.org

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Cabbage head caterpillar causes yield loss of up to 80% on cabbage.
What is it? (TIMP description)	Integrated management of cabbage head caterpillar is through the simultaneous application of a various options (cultural, biological and chemical). These are: **Cultural control** • Scout the crop twice weekly in order to detect the caterpillars before they move towards the growing centre of the plant. • Crop rotation and /or intercrop cabbage with mustard at every 15 rows of cabbage as a trap crop. • Field sanitation – remove weeds which can be host plant. • Conserve natural enemies like, spiders, parasitic wasps, praying mantis, ants, and birds by application of biopesticides. **Biological control** • Use botanical pesticide (e.g. fresh neem, lemongrass, ginger) 1 litre/15 litres of water. • Spray the crops with *Bacillus thuringiensis* to conserve natural enemies of the cabbage head caterpillars. **Chemical control** • Spray ACARAMIK 1.8EC (Abamectin 18g/L) according to manufacturer's recommendation • Spray ALBAZ 10 EC (Alpha-Cypermethrin 100g/L) according to manufacturer's recommendation • Spray Fenobucarb (e.g. Bascide); Use 20-30ml/8lit water; Non-systemic, contact action. Use only under high infestation
Justification	Cabbage head caterpillar cause considerable reduction in yield and lower cabbage quality. Losses of up to 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. Currently cabbage farmers use a lot of synthetic pesticides in their control. Integrated management of pests considering food safety concerns should be advocated considering that it is 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, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches to be used in	• On-farm trials and Demonstrations

dissemination	• ASK shows • Field days • Agricultural shows • 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 • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on cabbage webworm • Create a platform for interaction of cabbage value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of head caterpillar • Establishment of FFBS Mapping of head caterpillar free zones for up and out scaling of certified cabbage seed production funding by government to promote production and distribution of certified seeds at farm level
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities

C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting cabbage and losses attributed to them • Poor linkages among stakeholders in cabbage value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish cabbage 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	• KES 2000 as costs for insecticides and application per acre per season; KES 3000 per acre for insect traps. KES 3000 as labor and other costs for implementation of the rest of management practices in the IPM package per acre. Total basic costs; KES 8,000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	• Estimated returns KES 250,000 per acre • Farmers who do not use the IPM package lose 80% of KES 250,000 (i.e. a loss of 200,00) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop

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's)
Gender related opportunities	• Young male and female youth may be employed to monitor (pest scouting) and hand pick head caterpillars • Spraying of the crop during the corn earworm control 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 cabbage spraying programs.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• CABI- Plant wise Knowledge Bank
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	1-Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya**.** Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300

	E-mail: cd.narl@kalro.org.
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research gap:

1. Validation of use of agri-nets for management of pests in cabbages.

2. Development of surveillance software systems for monitoring pests in cabbage fields

3. Evaluate new cabbage varieties for tolerance to head caterpillar

2.7.1.11 TIMP name	**Intercropping cabbages with garlic and cabbages to control Cabbage head caterpillar.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Increased use of pesticides for the control of various pests in cabbage fields.
What is it? (TIMP description)	The TIMP entails planting cabbages and or garlic in between the rows of cabbages. Garlic and cabbages have some medicinal properties and are also aromatic. The aroma/smell released by the intercrops will chase away the pests from the cabbage plots thereby reducing the costs of pesticide's and at the same time make the end products safe for use.
Justification	Intercropping the cabbage fields with garlic will not only keep away the pests from attacking the cabbage crop but will also enable the farmer earn an extra income from the sale of the cabbages or garlic. The final product will also be safe to use, saves the farmer from the costs of pesticides and at the same time the practice is environmentally friendly.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Commercial cabbage nursery operators Extension Agents (Public and Private) Research organizations and universities CGIARs
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer training Agricultural shows and exhibitions Farmer to farmer training

Critical/essential factors for successful promotion	Strong partnership linkages Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended practices resulting to effective control of the pest.
Partners/stakeholders for scaling up and their roles	Extension service providers (Public and private) to help in the dissemination. CGIARs NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers. NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Change of mind set in favour of current practices maybe difficult to achieve. Farmers may lack technical knowledge on how to prepare and apply botanicals.
Suggestions for addressing the challenges	Capacity building and sensitization forums. Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness
Lessons learned in up scaling, if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	Organized collective marketing channels critical for benefits to be derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES. 60,000 per acre
Estimated returns	KES. 350,000 per acre.
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge. • Women have less access to land and credit that can be used for cabbage farming than men. • Women have limited access to education, training and extension services than men
Gender related opportunities	• Intercropping offers good opportunities to both men and women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits. • The management practices will reduce the production costs for women and youths who usually have less access to credit for cabbage cultivation • Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit. .
VMG issues and concerns in development,	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit

dissemination adoption and scaling up	for cabbage farming. • 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. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Intercropping offers good opportunities to VMGs to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	Cases to note are individual farmers and groups who are engaged in commercial cabbage production in major cabbage growing areas.
Application guidelines for users	Cabbage cultivation manual, brochure and fact sheet with detailed guidelines on approved cabbage pest management products. PCPB List of Approved Pest Control Products.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	3-Requires further research
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

2.7.1.12 TIMP name	**Use of plant extracts for control of cutworms in cabbage.**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Cabbage plants in the field and nurseries are usually attacked by a number of pests. Farmers have for a long time been struggling to control pests using chemical control practices with minimal success. At the same time, the agro-chemicals are expensive and unaffordable to the common farmer. The use of plant extracts for the control of pests will make the crop not only safe for consumption but also cheaper for the farmer.
What is it? (TIMP description)	Use of plant extracts for control of crop pests has been undertaken by farmers in various parts of the country. It involves the extraction of sap from leaves of medicinal plants for the control of pests. Such plants include neem, Tithonia, tobacco, pawpaw and chili plant. The extracts can be used alone or in combination so as to make them more effective and control more than one pest.
Justification	Demand for organically produced crop products has been on the increase in the recent years. These products also fetch premium prices in the market as they

	are free from chemical residues. Plant extracts do not contain heavy metals and are safe to the environment. Once sprayed onto the cabbage crop harvesting can be done as early as the following day without having to observe the post-harvest interval.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Commercial cabbage nursery operators Extension Agents (Public and Private) Research organizations and universities CGIARs
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer training Agricultural shows and exhibitions Farmer to farmer training
Critical/essential factors for successful promotion	Strong partnership linkages Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended practices resulting to effective control of the pest.
Partners/stakeholders for scaling up and their roles	Extension service providers (Public and private) to help in the dissemination. CGIARs NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers. NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Change of mind set in favour of current practices maybe difficult to achieve. Farmers may lack technical knowledge on how to prepare and apply botanicals.
Suggestions for addressing the challenges	• Capacity building and sensitization forums. • Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness
Lessons learned in up scaling, if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	Organized collective marketing channels critical for benefits to be derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES. 60,000 per acre
Estimated returns	KES. 350,000 per acre.

Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge. • Women have less access to land and credit that can be used for cabbage farming than men. • Women have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit. • Use of plant extract offers good opportunities to women and youth to use less chemicals for economic gains
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit for cabbage farming. • 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. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Use of plant extract offers good opportunities to VMGs to use less chemicals for economic gains. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	Efficacy trials have routinely been conducted by accredited institution such as KALRO in collaboration with PCPB
Application guidelines for users	Cabbage cultivation manual, brochure and fact sheet with detailed guidelines on approved cabbage pest management products. PCPB List of Approved Pest Control Products.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	3-Requires further research
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

2.7.1.13 TIMP name	**Evaluation of pesticides for effectiveness in control flea beetles in cabbage.**
Category (i.e. technology,	Management practice

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	There is lack of information by farmers and agro-dealers on the efficacy of most agro-chemicals that are in the market today. Many agro-chemical companies have manufactured different types of pesticides for control of various cabbage pests. However, their efficacies are not known while in some of them the information given on the labels does not seem to agree with the outcomes in the field once the pesticides are used for the control of pests. This therefore calls for an evaluation of the common pesticides in the market to determine their effectiveness.
What is it? (TIMP description)	The process will involve the purchase of the common pesticides used for the control of the economic pets for cabbage from the agro-dealers. The pesticides that are used for control of similar pests but manufactured by different agro-chemical companies will be procured and tested for their efficacy on the cabbage crop in different agro-ecological zones of the cabbage growing counties in the project mandate areas.
Justification	Farmers in the cabbage growing areas have used different kinds of pesticides for the control of various cabbage pests with very little success. This has led to many of them getting desperate owing to the high losses they incur in the process of cabbage production and resort to using acaricides meant to control ticks in cattle in the control of crop pests. This has exposed the consumers of cabbages into high health risks.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIARs
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer training Agricultural shows and exhibitions Farmer to farmer training
Critical/essential factors for successful promotion	Strong partnership linkages Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended practices resulting to effective control of the pest.
Partners/stakeholders for scaling up and their roles	Extension service providers (Public and private) to help in the dissemination. CGIARs NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers. NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.
C: Current situation and future scaling up	

Counties where already promoted, if any	-
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Change of mind set in favour of current practices maybe difficult to achieve.
Suggestions for addressing the challenges	Capacity building and sensitization forums. Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness
Lessons learned in up-scaling, if any	-
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 IPM to increase awareness of IPM and reduce possible negative impact on the environment resulting from wrong application of IPM. Vegetable markets are able to absorb increased supply of high-quality cabbages.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Finance for the application of various IPM components.
Estimated returns	Varied for food security and income from sales of surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge on the management practice. • The management practices reduce the production costs for women and youth who are mostly financially constrained • Women have limited access to education, training and extension services than men. Women and youth have less access to credit to purchase the chemicals
Gender related opportunities	Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit for cabbage farming. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	Efficacy trials have routinely been conducted by accredited institution such as KALRO in collaboration with PCPB
Application guidelines for	Cabbage cultivation manual, brochure and fact sheet with detailed

users	guidelines on approved cabbage pest management products. PCPB List of Approved Pest Control Products.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	3-Requires further research
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi
Lead organization and scientists	KALRO scientists: Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

2.7.1.14 TIMP name	**Community rangeland rehabilitation to increase populations of natural enemies for pest management in cabbage.**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Rangeland degradation due to overgrazing coupled with impacts of climate change. This has led to diminishing livestock feed and loss of natural resource base.
What is it? (TIMP description)	Rangeland rehabilitation consists of application of a range of TIMPs with the purpose of reclaiming the productivity of the rangelands. The ultimate goal is to reclaim the structure and functioning from the original system. Examples of TIMPs include multi-purpose agroforestry species, range reseeding and soil erosion control etc.
Justification	The rangelands cover three quarters of Kenya and underpin the livestock and wildlife industries. However, rangeland communities have low development indicators and face several growing threats. Severe droughts, land degradation and land subdivision have resulted in disrupted livelihoods. This has enhanced the vulnerabilities of people living in these lands.
Counties where the TIMPs will be up-scaled	Marsabit, West Pokot
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agro-pastoralists,
Approaches to be used in dissemination	Demonstration, local FM
Critical/essential factors for successful promotion	Timely disbursement of funds, Buy-in of technology from farmers and stakeholders
Partners/stakeholders for scaling up and their roles	County governments - Extension Farmers PPP

	Agro-pastoralists Kenya Met Services
C: Current situation and future scaling up	
Counties where already promoted	Garissa, Laikipia, Kajiado, Isiolo, Marsabit, Wajir and Baringo
Counties where the TIMPs will be up-scaled	Marsabit, West Pokot?
Challenges in dissemination	Low or non -existent skill and technology High costs associated with technology installation vis-à-vis longer lead time for accrued benefits Limited supportive policies
Suggestions for addressing the challenges	County government to create an enabling policy and institutional environment for sustainable rangelands management Increased community awareness on the benefits of rangeland rehabilitation Lobby for increased funding for rehabilitation efforts Increase public investment to strengthen local governance for community-based rangeland rehabilitation through revival of traditional systems Strengthen awareness of the economic values of rangeland rehabilitation and develop markets-based incentives Strengthen livestock market linkages to reduce pressure on the range resources
Lessons learned in up-scaling, if any	There are greater benefits from rehabilitation, though this takes a longer time Community awareness on the benefits of rehabilitation increases support or buy-in Policies that support and enforce rehabilitation in communal and tenure systems are key for success
Social, environmental, policy and market conditions necessary	Supporting environmental policies Capacity building on rangeland rehabilitation TIMPs
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on various factors like level of degradation and the TIMPs to be deployed
Estimated returns	Depends on various factors like TIMPs deployed and outputs from the rehabilitation efforts
Gender issues and concerns in development and dissemination	• Women have less access to information, technology and knowledge on the management practice. • Women have limited access to education, training and extension services than men. • Women and youth have less access to credit to purchase the chemicals
Gender issues and concerns in adoption and scaling up	Women have less access to this technology than men
Gender related opportunities	Employment opportunity exist for youth in reseeding
VMG issues and concerns in development and dissemination	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit for cabbage farming.

	• 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Employment opportunity for VMGs especially the youth in implementation of the management practice Need for capacity building on rehabilitation Deploy VMG friendly TIMPs with livelihood and income generation options
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	This will depend on the level of degradation and the TIMP being deployed
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 Resources, KALRO Secretariat
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	County government, PPP

Research gaps

Assessment of rangeland ecosystem change

Estimation of the potential carbon sequestration or GHG reduction in rangelands management

Economics of rangeland rehabilitation.

Assessment of future demand for forage, fuel wood, agriculture, or other uses from rangeland ecosystems

2.7.2 Cabbage Diseases

2.7.2.1 TIMP name	**Integrated Management of damping off disease in cabbage**  **Damping off disease affecting crucifers** **(Source: Igpress.clemson.edu)**

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 due to damping off disease
What is it? (TIMP description)	Integrated management package for damping off disease of in cabbages includes the use of cultural, biological and chemical options. The package has management options that are human and environmentally safe. These include the following: **Cultural control** • Identify a nursery site that is free from soil borne pathogens • For high rainfall areas, prepare raised nursery beds to avoid water logging • For moderate rainfall areas, flat nurseries would be suitable, for low rainfall areas sunken beds are recommended to conserve water. • Use clean disease free certified seed • Solarize nursery beds by exposing them to the hot sun during hot weather to destroy pathogens and pests in the soil. Solarization may be enhanced using a plastic sheet to increase temperature build up in the nursery beds • Avoid waterlogging as these favors pathogens (especially *Rhizoctonia* spp. *Pythium* spp. *Phytophthora* spp.) which cause nursery diseases • Monitor the nursery for disease symptoms for timely management • Practice hygiene by disinfecting farm tools in Jik solution (50ml: litre) to prevent spread **Biological control** • Drench Trichorderma based biocontrol agents including Rootgard, Trichotech, Trianum-P or Eco-T at planting **Chemical control** • Drench the nursery with chemical fungicides e.g. Bendazim 500SC, Rodazim SC and Propamocarb hydrochloride and Fosetyl aluminum based products e.g. Previous. Pesticides should be used according to manufacturers' recommendation
Justification	Damping off disease is a major disease that affects cabbage seedlings in nurseries. Pathogens that cause this disease, including *Rhizoctonia* spp. *Pythium* spp. *Phytophthora* spp and *Fusarium* spp occur. Failure to observe rotation of nursery sites and prevention of water logging may contribute to the severity of the disease which causes rotting at the soil line and the lower part of the seedling stem. Losses of 50-100% have been experienced in nurseries where waterlogging is a problem. It causes production of weak seedlings that may transfer the disease to the field and

	lead to increased costs of management. An integrated disease management approach enables the control of the disease through recommended cultural, biological and chemical practises which create unfavourable conditions for the soil borne pathogens in nurseries.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	• Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
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	- Extension service providers (Public and private) to help in the dissemination. - CGIAR's -Dissemination - NGOs: Dissemination through on-farm demonstrations; capacity building of farmers - County governments-Help in promoting and dissemination of the IDM options
C: Current situation and future scaling up	
Counties where already promoted, if any	The management practices have been promoted to cabbage and cabbage farmers across the country
Counties where TIMPs will be up-scaled	KCSAP target Counties and other regions where cabbage is grown
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 (soil testing, use of clean seedlings, field sanitation, rotation of nursery sites, biological control using *Trichorderma* based products in managing the disease at nursery level.
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 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. 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 cabbage
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of certified seed, pesticides and labor in nursery preparation and maintenance KES 4,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices, the seedlings loss could be reduced by about 50%. Therefore, the estimated returns after planting in the field will be KES 50,000 to 110,000 per acre
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for Damping off due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM for Damping off because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for Damping off • IDM for Damping off is cheap and reduces production costs therefore user friendly to poor women

	• Where IDM for Damping off will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM protocols for Damping off will not overburden any gender in implementation and are therefore has potential for adoption by both gender.
Gender related opportunities	- There will be creation of job opportunities for the youth in setting traps and marketing pest traps - Adoption of IDM for Damping off will lead to improved productivity of Cabbage hence more income for women - Adoption of IDM for Damping off will also lead to increased food security and nutrition for households - IDM adoption for Damping off will lead to employment opportunities for women and youth at various nodes of Cabbage value chain - There will also a reduction of cost of production for women if IDM for Damping off is adopted. -
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM for Damping off • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Cabbage diseases • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	The management practice 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	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi. ISBN: 92 9064 148 7
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 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Kitale) Anastacia Masinde KALRO (FCRC Muguga South)-Robert Agumbah ; Opondo R KALRO (FCRC Kabete)-Otipa Miriam KALRO (Headquarters)-Dr. Lusike Wasilwa KALRO (Headquarters) –Violet Kirigua KALRO (FCRC Kandara) =Muriuki S.K; Ndungu B
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments - Ministry of Agriculture

Research Gaps:

Explore the efficiency of using biocontrol agents and solarisation in management of various fungal soil borne pathogens at nursery level

2.7.2.2 TIMP Name	**Integrated Management of Black rot (*Xanthomonas campestris* pv. *Campestris*) of cabbage**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Rotting of the cabbage heads that leads to 100% field crop loss and marketability  Black Rot of cabbage (Source: Ruth Amata, KALRO)
What is it? (TIMP description)	Integrated management of black rot disease of cabbage involve scouting for initial disease symptoms and use of various management options that enhance field sanitation. The strategies include cultural, biological and chemical control measures. The IPM package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with scouting / monitoring for diseases, disease identification and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 3-4 years • Use of clean disease free certified seed • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Ensure the fields are weed free since some serve as alternative hosts to the pathogen • Destroy infected plant residues by burying 3 ft. deep to reduce inoculum on the farm

	Chemical control • Use copper based fungicides e.g. Cuprocaffaro (Copper oxychloride 85%) or Champflo SC (Copper hydroxide50%) for prevention. Scouting should be done to be able to manage the disease early • Pesticides should be used according to manufacturers' recommendation
Justification	Black rot disease is a major challenge in cabbage production in Kenya. It occurs in all major production areas. It causes significant yield loss because it causes death of tissues, hence disabling the ability of the plant to photosynthesize. Losses of up to 50% have been experienced where the pathogen was soil borne at planting or seedlings were infected early. Integrated Disease Management is an environmental friendly approach that enables the control of the disease. It includes cultural practises and chemical control options that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Researchers • Extension Agents (Public and Private) • Research organizations/ universities / CGIAR's
Approaches used in dissemination	• On-farm demonstration • Field days • Agricultural shows • MoAFLC/Extension officers • Farmer to farmer • Mass media – "Mkulima programme" • Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Increased productivity per unit • Efficient pest and disease management tools • Safe use of chemicals • Plant clinics establishment • Strong partnerships linkages between research institutions, extension and farmers • 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. Information 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 respective roles.	MoAFLC, Counties, CIGs, VMGs, CGIARs
C: Current situation and future scaling up	
Counties where already promoted. if any	Nyandarua, Kiambu, Nyeri
Counties where TIMPs will be up-scaled	West Pokot and Marsabit
Challenges in development and 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 alternative integrated disease management practices (use of clean seed, field sanitation and tolerant varieties) in managing the disease.
Lessons learned in up scaling, if any	• Several options /approaches are advocated in IDM hence farmers can choose based on availability • 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 in the evaluation of management practices enhances 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. 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 cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Pesticides/acre and labor in applying the management practices KES 15,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices, the yield will be reduced by about 50%. Therefore, the estimated returns will be KES 50,000 to 110,000
Gender issues and concerns	• Women and youth have limited knowledge on IDM for cabbage black rot

in development and dissemination	due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for cabbage black rot IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for cabbage black rot • IDM for cabbage black rot is cheap and reduces production costs therefore user friendly to poor women • Where IDM for cabbage black rot will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender issues and concerns in adoption and scaling up	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for cabbage black rot will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for cabbage black rot will also lead to increased food security and nutrition for households • IDM adoption for cabbage black rot will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IDM for cabbage black rot is adopted.
Gender related opportunities	The management information will be relevant to the youth, women and men.
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 agricultural information and extension so they might not be aware of IDM for cabbage black rot • There is low adoption by VMGs due lack of awareness.
VMG issues and concerns in adoption and scaling up	Youth, VMGs may not afford to purchase pesticides
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for cabbage black rot will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for cabbage black rot will lead to employment opportunities for some VMGs such as the youths in spraying • There will also be a reduction of cost of production for VMGs if IDM for cabbage black rot is adopted.
E: Case studies/profiles of success stories	
Success stories	-

Application guidelines for users	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi. ISBN: 92 9064 148 7
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Require validation
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya**.**
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.,Opondo R. Amata R.L
Partner organizations	Ministry of agriculture Livestock and Fisheries Seed and chemical companies Universities, CABI

Research gaps

Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management.
Lack of facilities for quick diagnosis of the disease in most counties.

2.7.2.3 TIMP name	**Integrated management of Leaf spot diseases (*Alternaria* sp and *Mycosphaerella brassicicola*) of cabbages in cabbage**
Category (i.e. technology, innovation or management practice)	Management practice  Leaf spots on a cabbage leaf (Source: Ruth Amata KALRO)

A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses and poor quality cabbage due to leaf spot diseases
What is it? (TIMP description)	Integrated management for leaf spot diseases of cabbage involves scouting for initial symptoms of the disease for early intervention in management and establishment of incidences and severity of the disease which then guides on the control measures to be used. The Integrated Disease Management (IDM) strategies include cultural, biological and chemical control measures. The IPM package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with scouting / monitoring for diseases, disease identification and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 3-4 years • Use of clean disease free certified seed • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Ensure the fields are weed free since some serve as alternative hosts to the pathogen • Destroy infected plant residues by burying 3 ft. deep to reduce inoculum on the farm **Chemical control** • Use of recommended relatively safe (WHO Class III) fungicides with low PHI levels (e.g. Iprodione based-Iprode 500 and Azoxystrobin based-Maxidor) according to manufacturers' recommendation
Justification	Leaf spot diseases in cabbage are caused by *Alternaria* sp. and *Mycosphaerella* sp. and are a major challenge in cabbage production in Kenya. They occur in most production areas. The disease causes significant yield loss of about 20-30% both in terms of quantity and quality. Integrated Disease Management enables the alleviation of yield loss due to leaf spot diseases damage and increases yield and quality of cabbage using human and environmentally safe options.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIARs

Approaches to be used in dissemination	• Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IPM package. • 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	• Extension service providers (Public and private) to help in the dissemination. • CGIARs • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers. • NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Change of mind set in favour of current practices maybe difficult to achieve • Farmers are not receptive to some of the cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources
Suggestions for addressing the challenges	• Participatory evaluation of the IDM package or components in demonstrating their effectiveness to farmers and economic analysis to convince them on cost effectiveness • Capacity building and sensitization forums • Organize visits to farms adopting the practices
Lessons learned in up scaling, if any	-
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 • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Vegetable markets are able to absorb increased supply of high-quality cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Pesticides/acre and labor in applying the management practices KES 20,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices, the yield will be reduced by about 20%. Therefore, the estimated returns will be KES 80,000 to KES176,000 per acre
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for leaf spot disease due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for leaf spot disease IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for leaf spot disease • IDM for leaf spot disease is cheap and reduces production costs therefore user friendly to poor women • Where IDM for leaf spot disease will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for leaf spot disease will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for leaf spot disease will also lead to increased food security and nutrition for households • IDM adoption for leaf spot disease will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IDM for leaf spot disease is adopted.
VMG issues and concerns in development,	VMGs have limited access to credit to buy the required inputs such as disease free seeds and fungicides

dissemination adoption and scaling up	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 certified seed and information on new varieties and production techniques There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for leaf spot disease will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for leaf spot disease will lead to employment opportunities for some VMGs such as the youths in spraying • There will also be a reduction of cost of production for VMGs if IDM for leaf spot disease is adopted.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi. ISBN: 92 9064 148 7 • Cabbage, Kale, Brassicas. Infonet Bio vision.
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires more research)	2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100,Nairobi Nairobi, Kenya**.** The Centre Director KALRO Kabete, P.O.Box 14733 00800 Nairobi Kenya
Lead organization and scientists	KALRO, Ruth Amata, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

2.7.2.4 TIMP name	**Integrated Management of black leg (*Phoma lingam*) disease of cabbages**

	 **Black leg of crucifers** (Source:ag.umass.edu)
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 disease
What is it? (TIMP description)	Integrated management of black leg disease of cabbage involves scouting for initial disease symptoms and use of various management options that enhance field sanitation and prevent occurrence of the disease. The strategies include cultural, biological and chemical control measures. The IPM package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with scouting / monitoring for diseases, disease identification and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Practice crop rotation with non-cruciferous plants e.g. maize, beans, solanaceous (tomato, capsicum, eggplant) for at least 4 years • Use clean disease free certified seeds and seedlings • Solarize fields by ploughing and exposing them to the hot sun during hot weather to destroy pathogens and pests in the soil. • Ensure proper drainage and avoid waterlogging conditions as this could enhance spread • Ensure fields are weed free since some are alternative hosts • Prevent surface run-off which could spread the pathogen • Monitor plants for disease symptoms for timely management • Practice hygiene by disinfecting farm tools in Jik solution (50ml: litre) to prevent spread **Biological control**

	• Drench soil with Trichorderma based biocontrol agents including Rootgard, Trichotech, Trianum-P or Eco-T at planting and during growth **Chemical control** • Drench the soil with chemical fungicides e.g. Bendazim 500SC, Rodazim SC and Propamocarb hydrochloride and Fosetyl aluminum based products e.g. Previous. Pesticides should be used according to manufacturers' recommendations
Justification	Black leg disease of plants in the brassica family is a major challenge in cabbage production especially once fields are infested due to survival features in the soil. The disease is severe because the pathogen produces abundant survival structures in the soil. Crop rotation periods are also longer due to the nature of the pathogen which produces survival structures in soil. These causes significant yield loss of over 50% where the disease is spread through surface run off, since it leads to wilting and death of plants. Integrated disease management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety considering that the cabbage crop is consumed widely in large quantities among the Kenyan communities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
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	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be upscale	KCSAP target Counties and other regions where cabbage is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation due to small farms and limited economic resources
Suggestions for addressing the challenges	Training on alternative management options in the integrated disease management practices (use of clean disease free seedlings, 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 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. 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 cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Pesticides/acre and labor in applying the management practices KES 20,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management

	• If the farmer doesn't adopt the IDM practices, the yield could be reduced by up to 50%. Therefore, the expected returns would be KES 50,000 to 110,000
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for blackleg disease due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for blackleg disease IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for blackleg disease • IDM for blackleg disease is cheap and reduces production costs therefore user friendly to poor women • Where IDM for blackleg disease will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for blackleg disease will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for blackleg disease will also lead to increased food security and nutrition for households • IDM adoption for blackleg disease will lead to employment opportunities for women and youth at various nodes of Cabbage value chain
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM for blackleg disease • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for blackleg disease will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for blackleg disease will lead to employment opportunities for some VMGs such as the youths in spraying • There will also a reduction of cost of production for VMGs if IDM for blackleg disease is adopted.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas

	Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi. ISBN: 92 9064 148 7 • Cabbage, Kale, Brassicas. Infonet Biovision
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 tolerance of new varieties to pests and diseases needs to be established across 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 (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng; Harun Odhiambo; James Ndambuki, Robert Opondo KALRO Kabete)-Miriam Otipa KALRO (FCRC Kitale)-Anastacia Masinde KALRO (Headquarters) Violet Kirigua KALRO (Headquarters) Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Assess the tolerance of cabbage varieties to black leg disease
Further research is necessary to determine effective fungicides and biopesticides for the management of black leg of crucifers

2.7.2.5 TIMP name	**Integrated Management of bacterial soft rot disease of cabbage (*Pectobacterium carotovorum subsp. carotovorum*.) disease of crucifers**

	  **Bacterial soft rot affecting cabbage stem and leaves** (Source: Lusike Wasilwa) **Bacterial soft rot causing losses in crucifer's production** (Source: Ruth Amata KALRO)
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 soft rot disease of cabbage
What is it? (TIMP description)	Integrated management of bacterial soft rot disease of cabbage involves scouting for initial disease symptoms and use of various management options that enhance field sanitation and prevent the disease from establishing. The strategies include cultural, biological and chemical control measures. The IDM package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with monitoring and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 3-4 years • Use of clean disease free certified seed • Solarization whereby land is ploughed and soil is exposed to solar heat during hot months • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Ensure the fields are weed free since some serve as alternative hosts to the pathogen • Destroy infected plant residues by burying 3 ft. deep to reduce inoculum on the farm

	Chemical control • Use copper based fungicides e.g. Cuprocaffaro (Copper oxychloride 85%) or Champflo SC (Copper hydroxide50%) for prevention. Scouting should be done to be able to manage the disease timely • Pesticides should be used according to manufacturers' recommendation
Justification	Bacterial soft rot disease is a major challenge in cabbage production in Kenya, occurring in major production areas. Where the disease is experienced, losses of up to 100% can be experienced while in storage. The causal agent survives in the soil and in infected plant residues and could be a problem right from nurseries to field level and into storage. The disease is favoured by cool wet weather. Where it occurs, It causes significant yield loss because it leads to deterioration of plant tissues and eventually death. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through cultural practises that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	• Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	• Strong partnership linkages between research institutions, extension and farmers • 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. Information 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	• Extension service providers (Public and private) to help in the

up and their roles	dissemination • Researchers/CGIAR's –Validation, dissemination and promotion • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments –Help in the dissemination of the technology and promotion
C: Current situation and future scaling up	
Counties where already promoted, if any	• Mainly promoted in Kiambu County and other counties growing crucifers
Counties where TIMPs will be upscale	KCSAP target counties and other regions where cabbages are grown
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 alternative integrated disease management practices (use of clean disease free seed, field sanitation, 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 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. 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 cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Pesticides/acre and labor in applying the management practices KES 20,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices for control of soft rot, the yield could be reduced by up to 100%. Therefore, the farmers loses all his yield during postharvest
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for bacterial soft rot disease of cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for bacterial soft rot disease of cabbage IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for bacterial soft rot disease of cabbage • IDM for bacterial soft rot disease of cabbage is cheap and reduces production costs therefore user friendly to poor women • Where IDM for bacterial soft rot disease of cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles.
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for bacterial soft rot disease of cabbage will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for bacterial soft rot disease of cabbage will also lead to increased food security and nutrition for households • IDM adoption for bacterial soft rot disease of cabbage will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IDM for bacterial soft rot disease of cabbage is adopted.
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and

	extension so they might not be aware of IDM for bacterial soft rot disease of cabbage • There is low adoption by VMGs due lack of awareness. •
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for bacterial soft rot disease of cabbage will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for bacterial soft rot disease of cabbage will lead to employment opportunities for some VMGs such as the youths in spraying • There will also a reduction of cost of production for VMGs if IDM for bacterial soft rot disease of cabbage is adopted. •
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage cultivation Manual. Ochieng et al. 2016 • Cabbage, Kale, Brassicas. Infonet Bio vision. https://infonet-biovision.org/PlantHealth/Crops/CabbageCabbage-Brassicas
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling, 2-requires validation, 3-requires further research)
Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Ruth Amata; KALRO (FCRI Kitale) Anastacia Masinde KALRO (FCRC Kabete Otipa Miriam KALRO (FCRC Muguga) Vincent Ochieng; Harun Odhiambo., Ndambuki J., Muriuki S.K
Partner organizations	- Extension service providers - FAO - NGOs - CGIARs - County governments

2.7.2.6 TIMP name	**Integrated Management of downy mildew (*Peronospora* spp.) diseases of cabbage**   **Downy mildew affecting cabbage**
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 downy mildew disease which also lowers quality due to spots
What is it? (TIMP description)	Integrated management of downy mildew disease of cabbage involves scouting for initial disease symptoms and use of various management options that enhance field sanitation and prevent the disease by creating conditions that are unfavorable to development of the disease. The IDM strategies for this disease include cultural, biological and chemical control measures. The package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with monitoring and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 2-3 seasons • Use of clean disease free certified seed and seedlings • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Enhance good drainage-avoid waterlogged conditions • Avoid overhead irrigation that encourages splash of spores • Use recommended spacing to enhance aeration in the field • Ensure the fields are weed free since some serve as alternative hosts to the pathogen

	• Destroy infected plant residues by burying 2 feet deep to reduce inoculum on the farm **Chemical control** • Use of recommended (WHO Class III) fungicides with low PHI levels (e.g. Iprodione based-Iprode 500). Pesticides should be used according to manufacturers' recommendation
Justification	Downy mildew is a serious disease affecting cabbage production in Kenya, occurring in most production areas. The disease causes significant yield loss both in terms of quantity and quality. Failure to control the disease under favourable conditions may lead to losses of about 30% and compromise leaf quality. Integrated Disease Management enables the alleviation of yield loss due to downy mildew disease and hence increases yield and quality of produce using human and environmentally safe options rather than over-reliance on synthetic pesticides.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Farmer involvement will be necessary for successful implementation of the IPM package. - 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	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	KCSAP target counties (Marsabit) and other regions where cabbage is grown

Challenges in dissemination	Farmers are not receptive to some of the cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources.
Suggestions for addressing the challenges	Training on alternative integrated disease management practices (use of clean seedlings, field sanitation, crop rotation) in managing the diseases.
Lessons learned in up scaling, if any	- More than one approach is used 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. 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 cabbage
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Pesticides/acre and labor in applying the management practices KES 20,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices for control of soft rot, the yield could be reduced by up to 30%. Therefore, the estimated returns are KES 70,000 to KES 154,000
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for downy mildew disease of cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for downy mildew disease of cabbage IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for downy mildew disease of cabbage • IDM for downy mildew disease of cabbage is cheap and reduces production costs therefore user friendly to poor women

	• Where IDM for downy mildew disease of cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	- There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop - Adoption of IDM for downy mildew disease of cabbage will lead to improved productivity of Cabbage hence more income for women - Adoption of IDM for downy mildew disease of cabbage will also lead to increased food security and nutrition for households - IDM adoption for downy mildew disease of cabbage will lead to employment opportunities for women and youth at various nodes of Cabbage value chain - There will also be a reduction of cost of production for women if IDM for downy mildew disease of cabbage is adopted. -
VMG issues and concerns in development, dissemination adoption and scaling up	The management practice reduce the production costs therefore VMG's can afford to produce cabbages
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for downy mildew disease of cabbage will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for downy mildew disease of cabbage will lead to employment opportunities for some VMGs such as the youths in spraying • There will also be a reduction of cost of production for VMGs if IDM for downy mildew disease of cabbage is adopted
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage cultivation Manual. Ochieng et al. 2016 • Cabbage, Kale, Brassicas. Infonet Bio vision. https://infonet-biovision.org/PlantHealth/Crops/CabbageCabbage-Brassicas
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471 Centre Director KALRO Muguga South

Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata KALRO (FCRI Kitale) – Anastacia Masinde KALRO (FCRC Kabete)- Otipa Miriam KALRO (FCRC Muguga) Vincent Ochieng; Harun Odhiambo; James Ndambuki CABI-Duncan Chacha KALRO Headquarters- Lusike Wasilwa ; Violet Kirigua
Partner organizations	- Extension service providers - FAO - NGOs - County governments

Gaps

Validate cabbage varieties for tolerance to downy mildew disease

2.7.2.7 TIMP name	**Integrated Management of club root (*Plasmodiophora brassicae*) disease of cabbages**  **Club root disease affecting cabbage** (Source: ag.umass.edu)
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 due to club root disease
What is it? (TIMP description)	Integrated management of club root disease of cabbage involves scouting for initial disease symptoms and use of various management options that enhance field sanitation and prevent the disease by creating conditions that are unfavorable to development of the disease. The IDM strategies

	for this disease include cultural and chemical control measures. The package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides. Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with monitoring and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 3-4 years • Use of clean disease free certified seed and seedlings • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Enhance good drainage-avoid waterlogged conditions • Ensure the fields are weed free since some in the brassica family e.g. mustard serve as alternative hosts to the pathogen • Destroy infected plant residues by burying 3 feet deep to reduce inoculum on the farm • Use of Indigenous Technical Knowledge (ITK) in raising soil pH levels • Solarize soils by digging / ploughing the land to expose the soil to high temperatures during hot weather. **Chemical control** • Test soils to determine pH since the disease is favoured by acidic soils • Raise soil pH to 7.2 by using Dolomite lime to make conditions unfavourable to the pathogen
Justification	Club root disease is a serious disease affecting cabbage. It is favoured by acidic soils and is severe in such areas with low pH (acidic soils). Failure to observe crop rotation especially in areas where land is a challenge leads to higher severity cases and spread of the disease. It causes significant yield loss of over 50% where surface run off water is able to spread the disease. It causes swelling of the root system and blocks the vascular system of the plant preventing water and nutrient uptake. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through recommended cultural practises with create unfavourable conditions for the pathogen.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers

	- Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
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	- Extension service providers (Public and private) to help in the dissemination - Researchers / CGIAR's –Dissemination - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	The management practices have been promoted mainly to farmers in Kiambu County
Counties where TIMPs will be up-scaled	Counties where cabbage is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation due to small farms and limited economic resources. Affordability of dolomite lime and its application could be a challenge to some farmers
Suggestions for addressing the challenges	• Training on alternative integrated disease management options (soil testing, use of clean seedlings, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's on a small scale) in managing the disease. • Capacity building on use of dolomite lime and its application
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 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. 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 cabbage
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of Certified Seed/acre, Dolomite calcium and labor in applying the management practices KES 30,000
Estimated returns	• Estimated returns are approximately Ksh 100,000 to 220,000 per acre depending on cabbage variety and management • If the farmer doesn't adopt the IDM practices for control of soft rot, the yield could be reduced by up to 50%. Therefore, the estimated returns are KES 50,000 to KES 110,000
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for club root disease of cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for club root disease of cabbage IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for club root disease of cabbage • IDM for club root disease of cabbage is cheap and reduces production costs therefore user friendly to poor women • Where IDM for club root disease of cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles

Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for club root disease of cabbage will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for club root disease of cabbage will also lead to increased food security and nutrition for households • IDM adoption for club root disease of cabbage will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IDM for club root disease of cabbage is adopted. •
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM for club root disease of cabbage • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for club root disease of cabbage will lead to improved productivity of Cabbage hence more income for VMGs IDM adoption for club root disease of cabbage will lead to employment opportunities for some VMGs such
: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern Africa. ICIPE Science Press, Nairobi. ISBN: 92 9064 148 7 Cabbage, Kale, Brassicas. Infonet Bio vision
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 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471

Lead organization and scientists	KALRO (FCRC Kabete)- Ruth Amata; KALRO Kabete (FCRI Kabete) Miriam Otipa KALRO (FCRC Muguga) Vincent Ochieng; Harun Odhiambo., James Ndambuki; Robert Tabu KALRO (FCRC Kitale)- Anastacia Masinde Lusike Wasilwa (KALRO Headquarters)
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps:
Evaluate cabbage varieties for club root disease tolerance

2.7.2.8 TIMP name	**Integrated Management of powdery mildew (*Erysiphe cruciferarum*) disease of cabbages**  **Powdery mildew affecting cabbage leaves** (Source; A.M Varela ICIPE)
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 disease
What is it? (TIMP description)	The Integrated Disease Management (IDM) strategies for the control of powdery mildew include cultural, biological and chemical control measures. The IPM package is environmentally, economically and human friendly since it does not encourage overdependence on pesticides.

	Cultural practices that prevent the disease are employed first. Thereafter, chemical disease control measures may be applied. These management practices start with scouting / monitoring for diseases, disease identification and establishment of incidences and severity of the disease which then guide on the control measures to use among the following: **Cultural control** • Crop rotation with crops in alternative families e.g. beans, maize, spinach etc. for 2-3 seasons • Use of clean disease free seeds/seedlings • Avoid overcrowding and use recommended spacing to enhance aeration • Avoid overhead irrigation which spreads the disease through splash • Spray using solution comprising of 1 tablespoon of baking soda, 1 teaspoon vegetable oil in 4 litres water before disease becomes severe, • Field hygiene through disinfection of farm tools with Jik (50ml/1litre water) • Ensure the fields are weed free since some in the brassica family e.g. mustard serve as alternative hosts to the pathogen • Destroy infected plant residues by burying 2 ft. deep to reduce inoculum on the farm **Chemical control** • Use of recommended relatively safe (WHO Class III) fungicides with low PHI levels (e.g. Iprodione based-Iprode 500 and Azoxystrobin based-Maxidor)with 2-3 days PHI intervals according to manufacturers' recommendation
Justification	Powdery mildew is a serious disease in cabbage production in Kenya, occurring in all production areas. The disease is severe because the pathogen produces abundant spores which cover leaves and area able to spread easily by air and splash reducing the plants photosynthetic area. This causes significant yield loss both in terms of quantity and quality. Where the disease is not controlled and under favourable conditions losses of up to 50% have been experienced. Even where the crop is not totally wiped out it is the quality is compromised. Integrated Disease Management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety considering that the cabbage crop is consumed widely in large quantities among the Kenyan communities.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
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 to farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be up scaled	KCSAP target Counties and other regions where cabbage is grown
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 disease free seedlings, 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 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. 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 cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Funds for bio-pesticides and biological control products are for needed for using some of the control practices as part of the IDM strategy Basic costs of about KES 20,000 per season
Estimated returns	- Management of powdery mildew would reduce losses by up to 50% where control measures are applied - Where management practices are not used, estimated returns of KES 50,000-110,000 estimated returns per year depending on variety and management
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for Powdery mildew disease of cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for Powdery mildew disease of cabbage IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for Powdery mildew disease of cabbage • IDM for Powdery mildew disease of cabbage is cheap and reduces production costs therefore user friendly to poor women • Where IDM for Powdery mildew disease of cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for Powdery mildew disease of cabbage will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for Powdery mildew disease of cabbage will also lead to increased food security and nutrition for households • IDM adoption for Powdery mildew disease of cabbage will lead to

	employment opportunities for women and youth at various nodes of Cabbage value chain • There will also be a reduction of cost of production for women if IDM for Powdery mildew disease of cabbage is adopted.
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 cabbages
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for Powdery mildew disease of cabbage will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for Powdery mildew disease of cabbage will lead to employment opportunities for some VMGs such as the youths in spraying • There will also a reduction of cost of production for VMGs if IDM for Powdery mildew disease of cabbage is adopted.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Cabbage Cultivation Manual. Ochieng et al. 2016 • Varela, A.M., Seif, A. A., Lohr, B. (2003). A Guide to IPM in Brassicas Production in Eastern and Southern
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 tolerance of new varieties to pests and diseases needs to be established across 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 (FCRC Kabete)- Ruth Amata; Miriam Otipa KALRO (FCRC Muguga) Vincent Ochieng; Harun Odhiambo; Robert Tabu KALRO (Kitale)-Anastacia Masinde KALRO (HRI Kandara)-Muriuki S KALRO (Headquarters)-Lusike Wasilwa; Violet Kirigwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps:

Explore the efficacy of bio-control options for powdery mildew disease in various AEZ's
Explore the use of ITKs in disease management at different stages of the disease
Validation of tolerance of new varieties to powdery mildew in various growing regions

2.7.2.9 TIMP name	**Seed dressing in cabbage for control of crickets.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Poor plant establishment is often associated with early pest and disease infestation. Seedling blights and damping off are common problems that lead to poor seed germination and seedling survival
What is it? (TIMP description)	Seeds are treated with chemical pesticides such as Thiram, Apron Star, Celest®Top, Cruiser® 350FS, Dividend® 030fs, Maxim Xl® 035FS, Seed Plus 30WS, Mancolax 72% WP, Marshal 350 ST, Protreat 350fs. This is especially important for seeds extracted by farmers. The seeds are placed in a container and the chemical applied according to the instructions on the label.
Justification	The technology offers protection to the seed and young seedling resulting in better germination and better plant establishment. It also stimulates root development leading to vigorous starts, uniform growth and higher yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agrovet dealers Commercial vegetable nurseries Extension Agents (Public and Private) Research organizations and universities CGIARs
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer field schools Farmer training Agricultural shows and exhibitions Farmer to farmer training
Critical/essential factors for successful promotion	Collaboration between all partners Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	County, farmer groups and CBOs for promoting the technology. Student interns for capacity building, Agrochemical companies and seed companies for provision of inputs. County governments, farmers groups/CBOs, NGOs, private nursery operators will implement extension.
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.

Challenges in dissemination	Unwillingness of farmers to embrace the technology Lack of funds to purchase seed dressers.
Suggestions for addressing the challenges	Economic analysis to convince growers on cost effectiveness. Stakeholder partnerships
Lessons learned in up scaling, if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	Guidelines on pesticide residue limits for cabbage. Favourable climatic conditions for cabbage production. Sustained market demand for high quality cabbage fruits.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Varies with seed dressing product.
Estimated returns	KES. 350,000 per acre
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IPM for control of crickets in cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for control of crickets in cabbage IPM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM for control of crickets in cabbage • IPM for control of crickets in cabbage is cheap and reduces production costs therefore user friendly to poor women • Where IPM for control of crickets in cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IPM for control of crickets in cabbage will lead to improved productivity of Cabbage hence more income for women • Adoption of IPM for control of crickets in cabbage will also lead to increased food security and nutrition for households • IPM adoption for control of crickets in cabbage will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IPM for control of crickets in cabbage is adopted.
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

	• VMGs have limited access to agricultural information and extension so they might not be aware of IPM adoption for control of crickets in cabbage • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM adoption for control of crickets in cabbage will lead to improved productivity of Cabbage hence more income for VMGs • IPM adoption for control of crickets in cabbage will lead to employment opportunities for some VMGs such as the youths in spraying • There will also a reduction of cost of production for VMGs if IPM for control of crickets is adopted.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• Brochure and fact sheet with detailed guide on seed dressing documented
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

2.7.2.10 TIMP name	**Quarantine and movement restriction for management of Bacterial soft rot and Black rot in cabbages.**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	High incidences of pests and diseases in Cabbage production systems.
What is it? (TIMP description)	This entails restriction of access to and movement within production areas. Strict procedures involving disinfection and cleaning are followed before access to production sites. Movement of animals into production site is eliminated and tools and other equipment and implements are cleaned before use in production places.
Justification	This is a preventive method that minimizes pest infestation. It is a first line of defence against pests that ensures minimal costs of dealing with pest outbreak. It contributes to product safety through minimal use of pesticides.

	Due to low pesticide usage production costs are also lower. This method targets bacterial and fungal diseases such as Black rot *(Xanthomonas campestris pv. campestris)* Bacterial soft rots (*Erwinia sp.* and *Pseudomonas sp) and* Downy mildew of cabbage *(Peronospora parasitica).* Targeted pest include; Vhite flies and sow fly.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agrovet dealers Commercial vegetable nurseries Extension Agents (Public and Private) Research organizations and universities CGIARs
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer field schools Farmer training Agricultural shows and exhibitions Farmer to farmer training
Critical/essential factors for successful promotion	Collaboration between all partners Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	Extension service providers: County extension staff, farmer groups and CBOs for promoting the management practice. Student interns for sensitizing farmers and building their capacity. Media for creating awareness
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up-scaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	Capital cost in setting up structures for restricting and controlling movement may be prohibitive for many farmers Limited access to credit for farmers
Suggestions for addressing the challenges	Linking farmers to funding sources
Lessons learned in up scaling, if any	-
Social, environmental, policy and market conditions necessary for development and up scaling	Guidelines on pesticide residue limits for cabbage. Favourable climatic conditions for cabbage production. Sustained market demand for high quality cabbage fruits.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Varies with seed dressing product.
Estimated returns	KES. 350,000 per acre

Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM for bacterial soft rot and black rot in cabbage due to lack of access to agricultural information and extension services • Women and youth might not be able to purchase the chemical used for bacterial soft rot and black rot in cabbage IDM because they do not have finances due to limited access to credit facilities • Some of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM for bacterial soft rot and black rot in cabbage • IDM for bacterial soft rot and black rot in cabbage is cheap and reduces production costs therefore user friendly to poor women • Where IDM for bacterial soft rot and black rot in cabbage will involve mulching it will add more work to women who are already burdened by their domestic roles
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps, marketing pest traps and spraying the crop • Adoption of IDM for bacterial soft rot and black rot in cabbage will lead to improved productivity of Cabbage hence more income for women • Adoption of IDM for bacterial soft rot and black rot in cabbage will also lead to increased food security and nutrition for households • IDM adoption for bacterial soft rot and black rot in cabbage will lead to employment opportunities for women and youth at various nodes of Cabbage value chain • There will also a reduction of cost of production for women if IDM for bacterial soft rot and black rot in cabbage is adopted.
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 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM for bacterial soft rot and black rot in cabbage • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM for bacterial soft rot and black rot in cabbage will lead to improved productivity of Cabbage hence more income for VMGs • IDM adoption for Damping off will lead to employment opportunities for some VMGs such as the youths in spraying • There will also a reduction of cost of production for VMGs if IDM for bacterial soft rot and black rot in cabbage is adopted.
E: Case studies/profiles of success stories	
Success stories	-

Application guidelines for users	• Brochure and fact sheet with detailed guide on seed dressing documented
F: Status of TIMP readiness (e.g. 1-Ready for up-scaling, 2-requires validation, 3-requires further research)	2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO Muguga South, P. O. Box 30148-00100, Nairobi
Lead organization and scientists	KALRO, Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	- Extension service providers, CGIARs, NGOs, County governments

Research gaps

Evaluation of pest/ pathogen diversity/ biotypes and distribution in cabbage growing regions.

3. Modelling the effect of climate changes on pathogen populations and their distribution as a predictor of future pesticide use trends.

2.7.3 Weed Management in Cabbage

2.7.3.1 TIMP Name	Integrated Weed Management in Cabbage
Crop management practices	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High incidence of annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yield.
What is it? (TIMP description)	Integrated Weed Management (IWM) is the management of weeds using two or more approaches including preventive, planting in a weed free prepared land (Physical), use of mulch (biodegradable or synthetic), cultural, rotation, intercropping and chemical control depending on the weed density. **Physical control** is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. First manual weeding is done at 4 weeks after transplanting and the second in about 2-3weeks after first weeding to control regrowth depending on environment, weeds present, rainfall or type of soils. **Chemical control** is where appropriate recommended herbicides are applied to control weeds. Herbicides may be pre-emergence or post-emergence. Or pre-plant soil incorporated. Cultural control is weed control by methods such as crop rotation and intercropping. Common weeds that are difficult to control in cabbage include: Wondering jew (Commelina benghalensis), sedges such as (Cyperus esculentus), Couch grass

	(D*igitaria abyssinica*), Purslane (Portulaca oleracea).   1. Wondering jew (*Commelina benghalensis*) 2. Yellow nut sedge (*Cyperus esculentus*)   3. Couch grass (D*igitaria abyssinica*) 4. Purslane (*Portulaca oleracea*) Mechanical weed control includes use of farm equipment such as sub-soilers hoes, slashers or a motorized knap weeder which does the work much faster and is less tedious. Chemical weed control weed control by use of pre-emergent selective and non-selective herbicides and or post- emergent selective and non-selective herbicides. In manual weeding farmers carry out first weeding at 2-3 weeks after germination and second weeding just before flowering (about 4-6 weeks)..
Justification	Different annual and perennial grass and broadleaved weed species combined with inappropriate approaches used to control weeds (because of limited knowledge) lead to yield losses of up to 100% in cabbage production. There is need to apply more than one approach to manage the weeds because they are biologically diverse and one approach will be effective on some species but not others. Majority of cabbage growers in Kenya use manual approaches to control the weeds. Whereas manual weeding can be effective for managing some weed species, it is time consuming and labour intensive. However manual weeding can also be ineffective especially when weeding is done under wet conditions for difficult or control weeds such as couch grass (*Cynodon dactyl on*), wandering jew *Commelina benghalensis* and purslane (*Portulaca oleracea*) get apparently disseminated and replanted through cuttings. Use of herbicides integrated with cultural methods gives a promising option for weed control in cabbage cropping systems. There is the need to apply IWM approach to control the biodiversity of weeds in cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers who will obtain high yield of good quality produce for sale • Extension service providers to use for training farmers

Approaches to be used in dissemination	• Farmer Participatory Evaluation • On-farm demonstrations • Field days, Farmer to farmer • MoAF&I/ Extension officers • Partners (FAO, ICRISAT, Farm Inputs Promotions FIPs, County government –Department of Agriculture) • Promotional materials (posters/brochures/leaflets, manuals, fact sheets) developed by KALRO, CABI, MoAF&I
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release Integrated Weed Management (IWM) in cabbage production • Training and promotion through demos and field days with farmer groups and stakeholders on the effectiveness of IWM using FFSB approach. • A platform for interaction of cabbage value chain stakeholders • Address environmental and safety concerns related to the use of herbicides • Train users on safe use of herbicide including timing to conserve biodiversity including pollinators for increased productivity. • Train stakeholders on biology and weed identification
Partners/stakeholders for scaling up and their respective roles.	• KALRO to do research, validate and upscale technologies on IWM • Extension service providers e.g. County officers, KILIMO trust and other NGOs for link to farmers, and assist in dissemination and promotions of the TIMP • FAO for promotion of Conservation Agriculture, • Cereal Growers Association (CGA) • Faith based organizations to help mobilize farmers across sects • Agrochemical companies and Agro-dealers to provide registered herbicides for weed control in cabbage.
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up-scaled	All Counties growing cabbage
Challenges in development and dissemination	Limited access to rural finance providers to purchase herbicides and land preparation implements such as sub-soilers Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders Low use of IWM technology Labour intensity for farmers who prefer only manual weed control Inadequate knowledge and information on which herbicides to use, when to use them and their persistence in the soil. Cultural beliefs by some farmers that herbicides destroy soils
Suggestion for addressing the challenges	• Promotion of the technology by conducting demos and field days and involvement of the stakeholder e.g. agro-chemical companies. • Develop and disseminate information to various stakeholders. • Training stakeholders on IWM approaches in cabbage using available methods • Persistence of herbicide residues in soil/ environment that can affect follow

	up crops in rotation. • Training on safe use of herbicides and awareness creation on health risks.
Lesson learned in up scaling if any	• Integrated weed management approaches are more effective than use of one method, and is environmental friendly. • Continuous use of herbicide is an environmental, health and social hazard which needs a break for some time. • Vegetable rotations are very fast and intensive in many places and herbicide toxicity can affect next crop if the cycle of previous crops is short enough. • Consumers concerns regarding the safety of crops due to pesticide residues needs to be considered
Social, environmental, policy and market conditions necessary for development and up-scaling	• Cabbage farming is socially acceptable • Conducive environment for cabbage production is needful • Market will absorb the increased produce • Supporting frameworks and policies are available • Train farmers to understand benefits of and how IWM works. • Address the environmental and social concerns related to use of agrochemicals by developing a safety plan to save pollinators. • A functional agro-dealer frameworks, policies and network to supply registered herbicides when required by the farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre, manual about KSH 11,000 per acre, 12 casuals per day@ Ksh 500 for 2 weeding's). Cost of herbicide is about KSH 5,000 per acre. Labour force and costs reduced to about KSH 900 (2 casuals for one day @ 500) when IWM is used, e.g. application of pre-emergent herbicide before planting to prevent weed germination.
Estimated returns	Cabbage yield is about 22,000kg per acre @20 = Ksh 440,000 per acre (varies with variety). Estimated returns per acre for manual weeding is Ksh 440,000 - 42,000 = Ksh 398,000 Estimated returns per acre for IWM Ksh 440,000 - 35,900 = Ksh 404,100
Gender issues and concerns in development and dissemination	• Women perform most of the crop production activities such as weeding hence the IWM reduce their work burden. • Women and youth have limited access to productive resources such as land and chemicals. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Increased productivity will benefit the household through sales and income. • Labour on the farms is reduced therefore opportunities will exist for women, youths and children who could get in other economic activities including marketing and schooling (children).
VMG issues and	• VMGs have limited access to productive resources such as land and chemical.

concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to education, training and extension services than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities.
VMG related opportunities	• Employment opportunities exist for youth males in spraying.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Guidelines available in brochures and manuals (Cabbage production guide) in KALRO Manuals, brochures, fact sheets on integrated weed management developed by KALRO and CABI/ Plantwise Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	Center Director KALRO Kabete, Waikiki Way P.O Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Momanyi V. N. (KALRO Kabete), Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

GAPs

Need to work out the cost benefit analysis which is important for upscaling of IWM in cabbage value chain

Upscaling of IWM has been done in crops such as maize, beans, dolichos but not cabbage.

2.7.3.2 TIMP Name	**Cabbage Intercropping System for weed control**
Categories (i.e. technology innovation Or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addresses	High incidence of annual and perennial grass and broad leaved weeds combined

	with poor management practice that lead to high labour costs, low and poor quality yields in cabbage value chain.
What is it? (TIMP description)	Intercropping system is the growing of two or more crops in a field at the same time as a means to enhance agricultural production, obtain efficient land use and manage weeds by reducing weed area. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. Appropriate legume crops such as beans, dolichos lab and mucuna puriens are planted in between rows of cabbage while ensuring the right spacing. There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Arrangement crops may be staggered 1-by-2 or 2-by-2 configuration between other crops, More complex intercropping systems with more than 2 crops have also been tested.
Justification	Planting specific selected legume crops such as faba bean (*Vicia faba* L.), *dolichos lablab* and *mucuna* in between cabbage rows effectively reduces weed density in the crop. The canopy of the legumes form a dense cover on the soil which acts as a physical barrier that prevents light from reaching weed seedling thus hindering their growth, and also further germination of new weed seeds. This decreases weed population density and biomass yield thereby reducing weeding costs. Intercropping significantly increases total productivity as compared to mono cropping because of better utilization of water, nutrients and solar energy. Crops in this system use available resources more efficiently because of increased root growth and canopy properties which exploit resources such as nitrogen fixed by legumes, or make available inorganic phosphorus in the soil. Intercropping has important advantages in regard to efficient land use, higher yield as well as productivity and profitability per unit land. The systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources and are profitable than mono-cropping systems. Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, color and trapping effects between intercrops influence insect or disease situation or the natural enemies. Success of intercropping systems over mono cropping can be achieved by timely planting, plant density, 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	Farmers, Extension Staff
Approaches used in dissemination	• Demos and field days • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Training workshops, Seminars, Meetings • Promotional materials (posters/ brochures/ leaflets, manuals)
Critical/essential factors for successful promotion	• Combine training, promotion, demonstrations, field days for farmer groups and stakeholders on effectiveness of intercropping weed management option in cabbage value chain using FFSB approach. • Applied and adaptive Research to test, validate and release intercropping in cabbage. • A platform for interaction of cabbage value chain stakeholders • Train stakeholders on weed identification in cropping systems.

Partners/stakeholders for scaling up and their respective roles.	County extension staff, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN)
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up-scaled	Counties such as Nyandarwa and Laikipia
Challenges in development and dissemination	• Inadequate training and limited extension staff • Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology due to lack of information
Suggestion for addressing the challenges	• Facilitation of training of county extension staff • Establish cabbage innovation platforms • Promotion of intercropping technology for cabbage value chain in suitable areas using demonstrations and field days and involvement of the stakeholders. • Develop and disseminate information to various stakeholders using manuals, fact sheets, brochures.
Lesson learned in up scaling if any	• Intercropping systems are knowledge intensive that require making adjustments in traditional ways of cropping. It 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	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre Manual weeding without intercrop is about KSH 12,000 per acre, 12 casuals per day@ Ksh 500 for 2 weedings). Manual weeding with intercrop is about KSH 6,000 per acre, 12 casuals per day@ Ksh 500 for one weeding). Second weeding not done because the legume ground cover prevents further weed germination and weakens growth of those that germinate.
Estimated returns	Cabbage yield is about 22,000kg per acre @20 = Ksh 440,000 per acre (varies with variety). Estimated returns where no intercrop is Ksh 440,000 - 42,000 = Ksh 398,000 per acre Estimated returns when intercropped is Ksh 440,000 - 36,000 = Ksh 404,000

Gender issues and concerns in development, dissemination adoption and scaling up	• Complexity of the intercropping system may result in increased labour for women who perform most of the crop's activities such as planting and weeding. • Women have less access to information, technology and knowledge. • Women have less access to land and credit that can be used for water melon farming than men. • Women have limited access to education, training and extension services than men.
Gender related opportunities	• Intercropping offers good opportunities women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits. • Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit for cabbage farming. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Intercropping offers good opportunities to VMGs to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	Murang'a
Application guidelines for users	Shanmugam S, Hefner M, Pelck S.J, Labouriau R. and Kristensen LH. Complementary resource use in intercropped faba bean and cabbage by increased root growth and nitrogen use in organic production. Soil Use and Management, 2022; 38:729-740. Available at: https://bsssjournals.onlinelibrary.wiley.com/ Extension and training material for cabbage intercropping system developed by KALRO, CABI/ Plantwise. Available at: Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Requires validation
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO, Momanyi V. N., Mwangi H., Otipa M. J., Masinde A.O., Ndungu B. W., Muriuki S. J., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J.,

	Ndambuki, J.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

Gaps

Upscaling of intercropping system has been done in crops such as maize, beans, dolichos but not cabbage

2.7.3.3 TIMP name	**Mulching for weed management**
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 infestation of annual and perennial grass and broad leaved weed species and improper weed control measures that lead to low and poor quality yields.
What is it? (TIMP description)	Mulching technology is the practice of covering the soil/ ground with natural or synthetic materials to effectively control germination of weed seeds in or at the soil surface using biodegradable or natural mulches. **Biodegradable/ organic mulches** include straw, grass and dead leaves. The mulches should be between 2-4 inches deep to effectively prevent weed germination and suppress the growth in cabbage fields. In addition the mulches retain moisture in the soil; keep the soil cool; and help improve soil fertility and improve microclimate when they decompose. **Synthetic mulches** solarize the soils, suppress weed growth, prevent seed germination and retain soil moisture. Inspect and pull out emerging weeds timely.
Justification	Black polythene prevents light from reaching the small weeds and seed germination. In addition to minimizing weed infestation mulches (such as straws and dry grass) facilitate retention of soil moisture there by controlling temperature fluctuations, improves physical, chemical and biological properties of soil by adding nutrients to the soil which can enhance the growth and yield of cabbage. It also improves soil structure directly by preventing impact of raindrop (soil erosion) and indirectly by promoting biological activity. Although a common farmer may not afford, synthetic mulches are easy to obtain and apply, and are reusable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers and farmer groups • Extension officers
Approaches to be used in dissemination	• On-farm demonstrations • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Training in workshops
Critical/essential factors for successful promotion	• Availability of plant or crop residues for organic mulches, cost of and disposal of synthetic mulch. • Size and availability of land. Size of the land is limited due to sub-divisions. Women who mostly do the farming customarily do not own land • Competing uses of crop residues.

	• Type of the crops
Partners/ stakeholders for scaling up and their roles	• Extension service providers (Public and private) to help in dissemination of the technology • County governments to help in the dissemination of the technology, Linking farmers to external markets • KALRO to provide Research, validation and upscaling • County governments and MoALF@I to provide extension services, farmer mobilization and policy formulation • NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted	None.
Counties where TIMP will be promoted	All Counties where cabbage is a priority value chain.
Challenges in dissemination	Lack of enough plant and crop residues due to competing uses of organic mulches. Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches. Small tears and rips which allow weeds to emergence (as early as six days after planting) through plastic or organic mulches and around the holes.
Suggestions for addressing the challenges	Establish cabbage innovation platforms Crop diversification to increase availability of organic mulches. Adapting alternative mulching materials like high absorbance polymers in cabbages. Monitor for any tears /rips and pull out any weeds without allowing them to take over.
Lessons learned in up scaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of mulching technology • Availability of market to sell produce is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • There is need to adapt to alternative mulching technologies in addition to use of organic materials.
Social, environmental, policy and market conditions necessary	Mulching in cabbage is socially acceptable and environmental friendly Increased productivity will provide supply to the markets Availability of supporting frameworks/ policies.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre. Cost of organic mulch is about KSH 4,000, depending on the type. Mulching is about KSH 2,000 per acre (2 casuals, 2days@500) to mulch. Mulching reduces weeding labour cost from KSH 12,000 (12 casuals, 2 weedings for one day @ 500) to Ksh 2,000 (uprooting few weeds that penetrate through mulches). **Basic cost** is KSH 30,000 + 4,0000 +2,000 + 10,800 = 46,800

Estimated returns	Cabbage yield is about 22,000kg per acre @20 = Ksh 440,000 per acre (varies with variety). Estimated returns with no mulching is Ksh 440,000 - 46,800 = Ksh 393,200 Estimated returns with mulching is Ksh 440,000 - 36,000 = Ksh 404,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• The management practice will reduce women's weeding time that can be used performing other productive activities. • Women have less access to information, technology and knowledge • Women have less access to land that can be used for cabbage farming than men • Women and youth have limited access to education, training and extension services than men
Gender related opportunities	• Employment opportunities exist for the unemployed youths in performing the operation. • Opportunities exist for women to use the readily l available on-farm mulch, to enrich their crop for increased productivity.
VMG issues and concerns in development, dissemination, adoption and scaling up	• The TIMP will reduce some VMGs weeding time that can be used in performing other productive activities • VMGs have less access to information, technology and knowledge • VMGs have less access to land that can be used for cabbage farming than men • VMGs have limited access to education, training and extension services than men • Mulching is labour intensive for some VMGs such as the elderly hence may not to be adopted.
VMG related opportunities	• Employment opportunities exist for the unemployed youths in performing the task.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None.
Application guidelines for users	Manuals, fact sheets on weed management developed by KALRO and CABI/ Plantwise. Available at; Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org
F: Status of TIMP readiness (1=Ready for up-scaling: 2=Requires validation;	1. Ready for upscaling

3=Requires further research	
G: Contacts	
Contacts	Centre Director KALRO-Kabete, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312, E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Mwangi H., Momanyi V. N., Otipa M. J., Masinde A.O., Ndungu B. W., Muriuki S. J., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	• Ministry of Agriculture, Livestock, Fisheries and Irrigation (MoALF) • NGOs (CARE Kenya):(Farmer Input Promotion) • ICRISAT • County governments

Gaps

Organic mulches are used in some crops but there is need to promote use of synthetic mulches.

2.7.3.4 TIMP Name	**Chemical Weed Control**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High incidence of annual and perennial grass and broadleaved weed species infestation, inappropriate, inefficient and unsustainable methods used to control weeds lead to low and poor quality yields.
What is it? (TIMP description)	Chemical weed control is a technology used to control the germination and growth of the weed species through application of chemicals/ herbicides to weeds or the soil. Herbicide weed control is a technology that requires knowledge on herbicides required for specific crops. Herbicides used to control weeds can be classified as pre- and post-emergent herbicides. **Pre-emergent herbicides** are applied on to moist soil after field preparation and within 24 hours after planting before both the crop and weed have emerged. An example is Atrazine (150-170 mls in 20 litres water) effectively prevents seed germination of weeds. **Post emergent herbicides** are applied on the germinated weeds. a) **Post-emergent selective herbicides** such as **2, 4-D** (100-150 ml in 20 litres water) sprayed between cabbage crops at 2-3 weeks after germination will effectively control broad leaved weeds. **Agil 100EC** will effectively control grass weeds at a rate of 100-200ml in 20 litres of water **Caution:** **Fix a hood on the nozzle while spraying between rows to protect damage to cabbage since it is also broad leaved. Spraying should only**

	be done after users have been trained and cautioned to the hazards. b) **Post-emergent non selective**, broad spectrum herbicides such as glyphosate (100-200 ml in 20 litres of water) mostly used in zero and minimum tillage may be applied as directed but guarded with a hood to avoid harming the crop.
Justification	Manual hand weeding is very labour intensive yet labour is scarce and expensive. Use of herbicides can reduce days spent weeding manually from 10-12 days per acre to nil - 2 days. This reduces labour costs from KSH 4,500-5,400 (10-12@450) to KSH 0-900 per acre and allows timely weed control. There are effective selective and non-selective pre and post emergent herbicides registered by PCPB for controlling narrow and broadleaved weeds in vegetables such as cabbage. Examples are mentioned above in the TIMP description.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers and farmer groups • Extension officers
Approaches used in dissemination	• On-farm demonstrations and experimentation • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Training and creating awareness in workshops • Field days, shows, farmer to farmer communication, leaflets,
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release chemical weed control technology in cabbage • Strong partnership linkages • Enabling environment for the successful implementation of the technology. • A platform for interaction of cabbage value chain stakeholders • Availability of registered herbicides for weed control at affordable cost. Some farmers may not afford to purchase the herbicides • Land availability Size of the land is limited due to sub-divisions. Women who mostly do the farming customarily do not own land • Disposal of empty herbicide containers is a challenge.
Partners/stakeholders for scaling up and their respective roles	Public and private partners –[MoAFLC) for extension, Chemical companies and agro-dealers for provision of registered herbicides. 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	

Counties where already promoted, if any	None
Counties where TIMPs will be upscaled	All Counties where cabbage is a priority value chain,
Challenges in dissemination	• Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of herbicide weed control technology in cabbage • Limited knowledge, information and low literacy levels among the farmers. • Herbicide use and application requires knowledge and training on safe and responsible use. Farmers need to understand the proper use including application to avoid buying the wrong herbicides.
Suggestions for addressing the challenges	• Establish cabbage innovation platforms • There is need to train the agricultural extension county officers as TOTs on appropriate use of herbicides. This will help in reaching out to farmers with the information. • Herbicides like all chemicals have to be used with care to avoid environmental, health and social hazards. Pollinators and other useful organisms need to be preserved. • Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on safe use of herbicides.
Lessons learned in up scaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of chemical weed control technology • Consumers concerns of herbicide residues in the environment/ soil and subsequent crops is of concern and needs attention. • Availability of market for the produce is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Access to and use of information on different weed control methods will reduce labour and cost of weed management. It could give room to increase area under cultivation and hence increase productivity.
Social, environmental, policy and market conditions necessary for development and up scaling	• Market availability to absorb increased produce • Availability of supporting frameworks/ policies and regulations • Sensitization of communities/ farmers on safe use of chemicals
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre. Manual weeding without herbicide application is about KSH 12,000 per acre, 12 casuals per day@ Ksh 500 for 2 weedings).

	Cost of herbicide is about KSH 5,000 per acre and KSH 500 to spray. Application of pre-emergent herbicides will reduce weeding cost from KSH 5,000 (2 weeding for 10 days @ 500) to nil. Total cost for manual is Ksh 30,000 + 12,000 = 42,000 Cost when herbicide is applied = 30,000 + 5,000 = 35,000 (no weeding cost).
Estimated returns	Cabbage yield is about 22,000 - 55,000kg per acre @20 = Ksh 440,000 per acre (varies with variety). Estimated returns with manual weed control is Ksh 440,000 - 42,000 = Ksh 398,000 Estimated returns with herbicide application is Ksh 440,000 - 35,000 = Ksh 405,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding activities therefore the TIMP will reduce their work burden. • Women and youth have limited access to productive resources such as land and chemicals. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and men in spraying.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals. • Women and youth have limited access to education, training and extension services than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Employment opportunities exist for youth males and men in spraying.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	.Non
Application guidelines for users	• Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use. • Rational use of herbicides. Eco friendly Weed Control options for Sustainable Agriculture. Science Alert. Review article. Scialert.net/full text/? • Weed control leaflets/ manuals, fact sheets developed by KALRO and CABI/ plant wise. Available at Training Manualshttps://www.kalro.org plant wise Knowledge Bank - CABI.orghttps://www.cabi.org
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Requires validation; 3. Requires	1. Ready for upscaling

Research **)**	
G: Contacts	
Contacts	Centre Director KALRO-Kabete, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312, E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Momanyi V. N., Mwangi H., Otipa M. J., Masinde A.O., Ndungu B. W., Muriuki S. J., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation (MoALF) NGOs (CARE Kenya) ICRISAT County governments Chemical companies and agro-dealers.

GAPs for further Research

Determine cost benefits of using synthetic and Biological chemicals versus other weed management strategies in cabbage production

2.7.3.5 TIMP Name	**Mechanical weed control**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	High incidence of annual and perennial grass and broadleaved weed species infestation, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yield.
What is it? (TIMP description)	Mechanical/ manual weed control technique manages weed populations through physical removal, injure, kill, or make the growing conditions unfavourable for growth by use of tools such as Pangas and jembes. Other methods may alter the growing environment by eliminating light, increasing the temperature of the soil, or depriving the plant of carbon dioxide or oxygen Land preparation is done manually using hoes or implements such as sub-soiler to kill weeds before planting. **Selective mechanical method** has little impact on non-target plants where as a **non-selective method** affects the entire area that is being treated. Land is prepared well using hand tools to get a weed free seedbed. Sowing is done in rows to facilitate inter- row weeding. Timely manual weeding is done 2-3 weeks after germination followed by a second weeding 2 to 3 weeks later depending on the rate of re-growth. The intra row weeds can also be removed by hand pulling.

	  1. *Sub-soiler for land tillage manually* 2. *Clean seed bed prepared* *Source: Hottensiah Mwangi* Delay in weeding should be avoided as it will result into severe competition with the crop. The right tools for weeding are used to avoid shock-stress on potato due to disturbance and root damage since the young crop is very sensitive. The intra row weeds can also be removed by hand pulling.
Justification	Weeds, if not controlled will take over, win the competition and cause significant yield losses of up to 100%. Deep tilling disturbs the soil and brings dormant weed seeds to the surface for germination. Some species which are deeply buried can remain dormant in the soil for years before favorable conditions allow germination. The fine soil allows weed seed to grow rapidly by allowing the seed to open and roots to spread easier than compact soils. These emerged weeds can be destroyed by mechanical tillage before planting or weeding after planting to get a clean crop that will give good yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers by obtaining high yield of good quality to improve their nutrition and income from sale of the produce • Extension service providers to use for training farmers
Approaches to be used in dissemination	• Farmer Participatory Evaluation • On-farm demonstrations and Field days • Mafia/ Extension officers • Partners (FAO, ICRISAT, Farm Inputs Promotions FIPs, County government –Department of Agriculture) • Promotional materials (posters/brochures/leaflets, manuals, fact sheets) developed by KALRO, CABI, MoAF&I
Critical/essential factors for successful promotion	• Awareness creation and demonstrations on importance and effectiveness of using mechanical method to control weeds in cabbage through field days, farmer groups and FFSB approach is effective • Training for users to build capacity on the importance of the technology. • Suitability of the TIMP to the agro-climatic and socio-economic condition of the farmer e.g. affordability of tools such as a sub-

	soiler for ploughing and harrowing. • Applied and adaptive Research to test, validate and release the technology for upscaling • A platform for interaction of cabbage value chain stakeholders is important to exchange ideas
Partners/ stakeholders for scaling up and their respective roles	Public and private partners –[MoALFC) for extension, Jua Kali artisans to make implements such as sub-soiler 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	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	All Counties growing cabbage
Challenges in dissemination	• Low use of the technology because implements such as a sub-soiler are not readily available in the market. • Limited access to rural finance providers to assist purchase implements such as sub-soiler • Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholder
Recommendations for addressing the challenges	• Work with Jua Kali industries for fabrication of appropriate implements. • Link farmers to rural finance providers such as Equity bank to assist farmers financially
Lessons learned in up scaling if any	• Access and use of technologies will provide timely weed control which will enhance crop production. • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technologies • Availability of market is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Access and use of appropriate weed management tools will provide timely weed control with reduced labour costs
Social, environmental, policy and market conditions necessary	• Sensitization of communities on the available technologies and management practices in weed management • Cultivation of cabbage is socially acceptable • Market to absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre. Manual weeding is about KSH 12,000 per acre, 12 casuals per day@ Ksh 500 for 2 weeding). Total cost is about = 42,000
Estimated returns	Yield is about 22,000kg per acre @20 = Ksh 440,000 per acre (varies with

	variety). Estimated returns when weeding done manually is Ksh 440,000 - 42,000 = Ksh 398,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities such as weeding hence the TIMP may increase their work burden. • Women and youth have limited access to land for cabbage farming. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities exist for unemployed youth in mechanical weeding.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cabbage farming. • 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. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Training of VMG on how to use implements such as a sub-soiler.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Manuals, brochures, fact sheets on integrated weed management developed by KALRO and CABI/ Plantwise. Available at; Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requires further research**)**	1. Ready for up-scaling
G: Contacts	
Contacts	Centre Director KALRO-Kabete, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312, E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Momanyi V. N., Mwangi H., Otipa M. J., Masinde A.O., Ndungu B. W., Muriuki S. J., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALF, extension staff in Counties

GAPs

Need to work out the cost benefit analysis which is important for upscaling and validation of mechanical weed control in cabbage.

2.7.3.6 TIMP Name	Solarization Bed for Weed Control
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	A rich dormant seed bank of diverse annual and perennial grass and broadleaved weed species in the soil which germinate, compete with the crop for growth resources such as nutrients leading to yield losses.
What is it? (TIMP description)	Solarization is a method where transparent/ clear polythene films/ plastic is used to heat the soil and kill weed seedlings and dormant seeds in the top six inches of the soil. This increases soil temperatures by about 10^0C or more than atmospheric. The basic phenomenon is building up of lethal high temperatures in the soil where most dormant and viable seeds are present.  Solarization of soil using transparent polythene film. Source: infonet-biovision.org The mechanism can increases soil temperature by 8-12 ^{o}C over non mulched soil which kills seeds and rhizomes of annual and perennial weeds if not deeply buried. Effectiveness depends on specific species and also the heating duration.
Justification	Solarization for two consecutive years is successful in controlling perennial weeds. The Mechanism effectively breaks the dormancy of weed seeds, solar scotching of emerged weed seedlings and direct killing of weed seeds by heat. Solarization with 0.05mm T Polythene sheets for 40 days is effective in controlling weeds than use of 0.01mm polythene and takes shorter time duration. This is a good ecological and environmental friendly method that is sustainable for small scale organic growers. If done properly, application of post-emergent herbicides is not necessary.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies

Approaches used in dissemination	• Farmer field and business Schools(FFBS) • Agricultural Innovation Platforms (AIP) • On-farm experimentation and dissemination • Demonstrations on larger plots • Field days, shows, farmer to farmer communication, leaflets, training on how to use Solarization.
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release solarisation bed technology weed control in cabbage varieties • A platform for interaction of cabbage value chain stakeholders • Development of the agronomic practice for cabbage • Capacity building and training on use of polythene and solar power.
Partners/ stakeholders for scaling up and their respective roles	• Public and private partners (MOALF&I) for extension. • Farmer Input Promotion (FIPs) 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	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	All Counties where cabbage of high value is grown especially for organic farmers.
Challenges in dissemination	• Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Limited knowledge and information and low literacy levels among the farmers. • Capacity building is required to impart knowledge and skills in appropriate use and application of Solarization. • Farmers need to understand proper use and application of Solarization bed to avoid buying inappropriate polythene and minimize health, environmental and social hazards.
Suggestions for addressing the challenges	• Establish cabbage innovation platforms • Need to train the agricultural extension county officers as TOTs on appropriate use of Solarization. This help in reaching the farmers with the information. • Disposal of polythene should be done carefully to avoid environmental, health and social hazards. • Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on reuse and polythene disposal.
Lessons learned in up	• Chances of successful scaling are higher when diverse value

scaling if any	chain stakeholders collaborate in an innovation platform. • Awareness creation through demonstrations and farmer field days help in adoption of the technology of Solarisation bed for weed control • Availability of market for the produce is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms. • 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 increased area under cabbage cultivation and increase productivity. • Solarization to control weeds is cheaper than manual weed control because it requires less labour and achieves timely weed management.
Social, environmental, policy and market conditions necessary for development and upscaling	Sensitization of communities on alternative methods of weed control and appropriate use of transparent polythene is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre. Cost of polythene and spreading on soil is Ksh 11,000.
Estimated returns	Yield is about 22,000kg per acre @20 = Ksh 440,000 per acre (varies with variety). Estimated returns with Solarization is Ksh 440,000 - 41,000 = Ksh 399,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding activities therefore the TIMP will reduce their work burden. • Women and youth have limited access to resources such as land and chemicals. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and men in spraying the weeds using glyphosate and other chemicals.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals. • Women and youth have limited access to education, training and extension services than men.

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Employment opportunities exist for youths in performing the operation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	• Muhammad A.K.etal., (2012). An approach to organic weed management. *J. Communications soil science and plant analysis.43:1847-60.* DOI:10.1080/DOI03624 • Ali El Kelby and Hamadi F.A (2009). Assessment of the differential response of weeds to soil solarization by two methods (2009). Research gate.net publications-230177258. *J. Weed biology and Management*. • KALRO and CABI weed control leaflets/ manuals, fact sheets Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org • Information and instructions always displayed on the labels attached to container on how to use.
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Requires validation; 3. Requires Research **)**	2. Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 340-90100 Machakos Email: cd.narl@kalro.org
Lead organization and scientists	KALRO. Violet N. Momanyi (KALRO Kabete)
Partner organizations	MoALF in Counties, Chemical companies.

GAPs for further Research

Need to work out the cost benefit analysis which is important for adoption and upscaling of Solarization technology

2.7.3.7 TIMP Name	**Stale seed bed for Weed Control**
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice	
Problem to be addressed	A rich dormant seed bank of diverse annual and perennial grass and broadleaved weed species in the soil which germinate and compete with the crop for growth resources such as nutrients leading to yield losses.
What is it? (TIMP description)	A weed management practice where weed seeds just below the soil surface are allowed/ stimulated to germinate after rainfall or wetting the soil and then killed prior to planting the potato seeds while minimizing soil disturbances. Weeds are killed using post-emergent herbicides such as glyphosate at a rate of 100-300ml in 20 litres of water, or ploughed into the soil. Non-residue Paraquat may also be used to destroy dense flush of young weed seedlings. This is followed by sowing cabbage. Several passes made in the soil with roto spike tooth hallow is useful to destroy the emerging weeds during preparation of stale beds.
Justification	The technology effectively controls broad and narrow leaved weeds that germinate and emerge before the crop is planted. Competition from weeds deprive cabbage of available resources leading to weak and stunted growth in the young crop depending on weed density and diversity, stage of weed growth and environment. Grass weeds such as crab sanguinalis (*Digitaria sanguinalis*) and couch grass which is difficult to control are killed after they germinate. Likewise broadleaved weeds such as datura (*Datura stramonium*), devils thorn (*Emex australis*) and black jack (*Bidens pilosa*) are killed. Weeds whose control is difficult and challenging but can be validated by this technology include: the sedges and wandering jew (*Commelina* species).
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers and farmer groups • Extension officers
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Training workshops, Seminars, Meetings • On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, demonstrations on larger plots. • Training on how to use stale bed.
Critical/ essential factors for successful promotion	• Applied and adaptive Research to test, validate and release stale seed bed for weed control in potato varieties • A platform for interaction of potato value chain stakeholders • Capacity building and training on use of polythene and stale bed
Partners/ stakeholders for scaling up and their roles	• Extension service providers (Public and private) to help in the technology dissemination • County governments to help in the dissemination of the technology, Linking farmers to external markets • KALRO to provide Research services • County governments and MoALF to provide extension services, farmer mobilization and policy formulation • NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted, if any	None

Counties where TIMPs will be upscaled	All Counties where cabbage is a priority value chain,
Challenges in dissemination	• Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Labour intensity at initial stages • Be aware of small tears and rips which will allow weeds to emergence through plastic mulches including around the holes as early as six days after planting.
Suggestions for addressing the challenges	• Establish cabbage innovation platforms • There is need to train agricultural extension county officers as TOTs on use of stale seed beds. This will help in reaching the farmers with the information. • Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on use of stale seed bed.
Lessons learned in up scaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technology • Availability of market for the produce is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • 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 market conditions necessary for development and up scaling	• Market availability to absorb increased produce • Availability of supporting frameworks/ policies • Technology to be socially acceptable • Sensitization of communities on alternative methods of weed control and appropriate use of stale seed beds is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour cost for tilling and harrowing using a sub-soiler is about Ksh 30,000 per acre. Cost of post-emergent herbicide and spraying is Ksh 5,500 per acre. Manual weeding without herbicide application is about KSH 12,000 per acre (12 casuals per day@ Ksh 500 for 2 weeding). No weeding when post-emergent herbicide is applied.
Estimated returns	Yield is about 22,000kg per acre @20 = Ksh 440,000 (varies with variety). Estimated returns with manual weeding is Ksh 440,000 - 42,000 = Ksh 398,000 Estimated returns when herbicide is applied is Ksh 440,000 - 35,500 = Ksh 404,500
Gender issues and concerns in development, dissemination, adoption	• There is need to sensitize both men and women on the value of crop losses caused from weeds and effectiveness of stale seed bed in controlling weeds. • Women and children are the main sources of labour.

and scaling up	• Women are involved in spraying to kill weeds induced to germinate before planting yet it is not recommended
Gender related Opportunities	• Women who mainly perform weeding tasks will get a relief and spend their efforts elsewhere. • Improved productivity will benefit women in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from access to benefits from improved technologies. Thus, affirmative action is required to promote cabbage for VMGs including value addition aspects.
VMG related opportunities	• Increased production will lead to increased consumption of cabbage which is high in nutrients 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 from previous similar projects	None.
Application guidelines for users	• Information and instructions always displayed on the labels attached to container on how to use. • Guihua Chen and Cerruti RR Hooks (2021). The Stale Seedbed Technique: A Relatively Underused Alternative Weed Management Tactic for Vegetable Production. https://extension.umd.edu/resource • Manuals, leaf lets, fact sheets on weed management developed by KALRO and CABI/ Plantwise available at; Training Manualshttps://www.kalro.org Plantwise Knowledge Bank-CABI.orghttps://www.cabi.org
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 P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO; Violet N. Momanyi (KALRO Kabete)
Partner organizations	• Ministry of Agriculture, Livestock, Fisheries and Irrigation (MoALF) • NGOs (CARE Kenya) • ICRISAT • County governments

GAPs for further Research

Need to work out the cost benefit analysis which is important for adoption and upscaling of stale seed bed technology

2.7.3.8 TIMP Name	Safe Use of herbicides
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Excessive herbicide application to crops and the soil, spraying without wearing protective clothing, storage in non-designated areas, wrong application techniques, spraying at the wrong times and against the wind, and use without following guidelines on the labels (e.g. rate and Pre-Harvest Interval), wrong disposal of expired herbicides and empty containers, inadequate enforcement of global and national policies and regulation safe use of pesticides.
What is it? (TIMP description)	The technology includes methodologies for proper herbicide handling, application, and disposal of left overs and containers in order to minimize pollution of the environment and contamination of the produce.  Full protection while spraying is recommended. *Source: Hottensiah Mwangi* Capacity building of farmers, crop protection spray teams on safe handling and use of herbicides right from transportation from the agro-dealers to storage in their houses, 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.
Justification	Cases of improper and misuse use of pesticides are very common in most of the areas where crops is grown yet 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 to be made aware of the best practices that should be used when handling herbicides. Increase of chronic diseases in human beings resulting from pesticide exposure has been reported.
B: Assessment of dissemination and scaling up/ out approaches	

Users of TIMP	• Farmers by being informed on need to reduce exposure to chemicals • Extension service providers to use for training farmers
Approaches used in dissemination	• Farmer field and business Schools(FFBS) • Agricultural Innovation Platforms (AIP) • Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, demonstrations on pesticide spraying.
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and employ safe use of herbicides in cabbage production • A platform for interaction of cabbage value chain stakeholders • Development of agronomic practices for cabbage • 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 to conduct extension services and farmer trainings, Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for cabbage production • KALRO and relevant Universities to develop the technologies and conduct ToTs, including AAK, PCPB, KEPHIS.
C: Current situation and future scaling up	
Counties where already promoted, if any	Bungoma, Kakemega, Machakos, Kiambu, Kisumu, Kericho, among others
Counties where TIMPs will be up-scaled	All countries using pesticides in crop production
Challenges in dissemination	• Lack of cabbage innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of technology • Labour intensity and requires skilled man power • Change of mindset in favour of current practices maybe difficult to achieve. • Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of herbicides. • Use of banned and expired pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose herbicides (pesticides) properly
Suggestions for addressing the challenges	• Establish cabbage innovation platforms • Capacity building and sensitization forums for both farmers and agro dealers using participatory approach. • Formations of youth spray teams. • Establishment of aggregation centres for the disposal of pesticide containers • Establishment of training of Extension staff and lead farmers as TOT.

	• Increase surveillance along the border points and enforce the laws to prevent smuggling in of unregistered herbicides.
Lessons learned in upscaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of technologies • Availability of registered herbicides is essential • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Consumers concerns of herbicide residues in the soil and subsequent crops needs attention • Upscaling of this technology needs young men and youth to do the spraying. • The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of herbicides in some areas.
Social, environmental, policy and market conditions necessary	• Address the environmental and social concerns related to use of agrochemicals by developing a safety action plan. • A functional agro-dealer frameworks, policies and network to supply registered herbicides when required by the farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of complete set of protective clothing is about KES 5,000
Estimated returns	Not applicable. The TIMP takes care of the herbicide applicator
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding activities therefore the TIMP will reduce their work burden. • Technology is not safe for use by women especially expectant ones and the physically challenged individuals because of associated risks/ toxic nature • Women and youth have limited access to credit to purchase herbicides and protective clothing. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and men in spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• Herbicides are dangerous products that may not be handled by vulnerable groups. • VMGs have limited access to productive resources such as land, credit and chemicals. • Women and youth have limited access to education, training and extension services than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• Employment opportunities exist for youth males and men in spraying
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 herbicides. Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms. Safe use of Pesticide campaigns by AAK, PCPB, KALRO and MoALFC
Application guidelines for users	1. Momanyi Violet (2017). Guidelines for Safe and Effective Use of Pesticides: Safety Measures for Pesticide Users. A hand book published by Lap lambert Academic Publishing. Available at: https://www.amazon.com/Guidelines-Safe-Effective-Use-Pesticides/dp/6202006218 2. Manuals, brochures, fact sheets on integrated weed management developed by KALRO and CABI/ Plantwise Training Manualshttps://www.kalro.org Plantwise Knowledge Bank - CABI.orghttps://www.cabi.org
Status of TIMP readiness (1. Ready for up-scaling; 2. Requires validation; 3. requires further research)	Ready for up-scaling
F: Contacts	
Contacts	Centre Director KALRO-Kabete, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312, E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO scientists: Momanyi V. N., Mwangi H., Otipa M. J., Masinde A.O., Ndungu B. W., Muriuki S. J., Ochieng V., Esilaba A.O., Nasirembe W., Odhiambo H., Ndubi J., Ndambuki, J.
Partner organizations	MoALFC, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

GAPs

Need to work out the cost benefit analysis which is important for upscaling on safe use of herbicides.

Herbicides are misused and wrongly used many times. There is need to educate stakeholders on the risks.

2.8 Post-Harvest Management of Cabbage

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

Problem to be addressed	Losses due to incorrect timing of harvest and inappropriate harvesting methods.
What is it? (TIMP description)  Mature cabbage crop ready for harvesting	This is a management practice involving careful maturity indices, pre-harvest operations and harvesting procedure. <u>Maturity indices and correct time for harvesting:</u> Cabbage is harvested at an average of 65-110 days after planting, depending on the variety. At this stage, the heads are substantial and ripened. Maturity is based on head compactness and firmness to crisp. <u>Harvesting</u>: Harvesting of cabbage is done either manually or by machines (combine harvester) Manual harvesting is done by cutting the head with a sharp knife or a sickle. Farmers cut the plants at soil surface leaving loose outer leaves attached to the stalk. The cabbages are stacked in clean crates ready for transportation. Mechanical harvesting is possible by use of a combine harvester if the crop has matured uniformly.
Justification	Incorrect timing of harvesting and inappropriate harvesting methods leads to losses of cabbage yield. Harvesting before the maturity of the crop results in lower yields and higher proportion of immature heads and the heads are too soft to resist handling**.** Delay in harvesting results in head splitting, cracking and other losses caused by birds, insects, moisture, bruising and opportunity to microbial attack. Timely observation of maturity indices, and parameters is essential to maximum yield attainment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors and extension agents
Approaches used in dissemination	On farm and on station demonstrations, agricultural exhibitions, Field days Agricultural shows, Extension officers, Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop Increase of productivity per unit Application of harvesting technologies
Partners/stakeholders for scaling up and their roles	Agricultural Extension: Farmer sensitization, on-farm and on-station demonstrations Market players to create demand and pull production Farmer leaders: Group organization NGOs dealing with cabbage to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu, Nyeri, Nyandarua, Murang'a, Embu, Meru, Laikipia, Nakuru
Counties where TIMP will be up-scaled	Machakos, Uasin Gishu, Kericho, Tharaka Nithi
Challenges in dissemination	Lack of knowledge on maturity indices and appropriate harvesting technology Negative attitude by farmers towards adoption of new agricultural TIMPs Low uptake before the farmers see results
Suggestions for	Awareness creation about the TIMP to farmers and traders

addressing the challenges	Capacity building of farmers on maturity indices and appropriate harvesting Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	• Involvement of stakeholders such as CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitizations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	Farmers will be willing to adopt the technology There will be favourable policy for adoption of the technology The market will be able to absorb saved grain from reduced harvesting losses
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not possible to quantify amount since scale of production varies
Estimated returns	Reduced losses, better income and nutrition (due to appropriate harvesting techniques)
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge on the management practice. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	The management practice increases farm income through reduction of harvest losses. Both men a women can capitalize on this aspect of cabbage production to reduce harvest losses.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge on the management practice. • 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 • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Adoption of the TIMP means reduced losses, hence more cabbage available for consumption and sale. This will enable VMGs to have enough cabbage to consume, hence get macro- and micro-nutrients (especially minerals). There will be more income for the farmers (VMGs).
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in central Kenya have adopted the technology
Application guidelines for users	MOALFF / SHEP PLUS. Cabbage Production. Ministry of Agriculture, Kenya. Wayua, F., Ndambuki, J. Masinde, A.A.O. and Wasilwa, L. (2021). Maturity indices for cabbage. KALRO/KCSAP Programme Factsheet No. #
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Ready for upscaling
G: Contacts	

Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps:
Quantification of the losses due to incorrect timing of the right maturity for harvesting different cabbage varieties
Quantification of losses of manual vs. mechanical cabbage harvesting, including the cost-benefit analyses of each method.

2.8.2 TIMP Name	**Sorting and grading of cabbage**
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 and ungraded cabbages
What is it? (TIMP description)	Sorting is done to remove yellowed, damaged, diseased wrapper leaves, insect damage, rotten leaves and debris. Grading is categorization of cabbage according to size, weight, maturity, physical damage, and market demand.
Justification	Sorting helps to eliminate cabbages of poor quality and prevent cross contamination between spoilt and good vegetables. Cabbages of superior quality fetch higher prices in the market. Sorting and grading helps in increasing shelf-life of cabbage produce while transporting to distance places.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors
Approaches used in dissemination	On farm and on station demonstrations, agricultural exhibitions, field days Agricultural shows, extension officers, Mass media – Agricultural programs, promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop Increase of productivity per unit Application of appropriate harvesting technologies
Partners/stakeholders for scaling up and their roles	Agricultural Extension: Farmer sensitization, On farm and on station demonstrations Market players to create demand and pull production Farmer leaders: Group organization NGOs dealing with Cabbage to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Kiambu, Nyeri, Nyandarua, Murang'a, Embu, Meru, Laikipia, Nakuru

Counties where TIMP will be up-scaled	Machakos, Uasin Gishu, Kericho, Tharaka Nithi
Challenges in dissemination	Lack of knowledge on appropriate sorting and grading technology Negative attitude by farmers towards adoption of new agricultural TIMPs Low uptake before the farmers see results
Suggestions for addressing the challenges	Awareness creation about the technology to farmers and traders Capacity building of farmers on appropriate sorting and grading Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	• Involvement of stakeholders such as CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitizations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	Farmers will be willing to adopt the technology There will be favourable policy for adoption of the technology The market will be able to absorb saved grain from reduced harvesting losses
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income and nutrition (due to appropriate sorting and grading techniques)
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community levels
Gender related opportunities	• Employment opportunity exist for and women in sorting and grading
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to land. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunity exist for some VMGs especially women sorting and grading.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Kiambu, Nyeri, Nyandarua, Murang'a, Embu, Meru, Laikipia, Nakuru have adopted the TIMP
Application guidelines for users	MOALFF / SHEP PLUS. Cabbage Production. Ministry of Agriculture, Kenya.
F: Status of TIMP readiness	Requires validation

(Ready for up scaling; Requires validation; Requires further research**)**	
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161:
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gap
Validation of mechanization grading of cabbage

2.8.3 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 (50%) caused by lack of cooling technologies for cabbage
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. The zero energy Brick cooler can be customized according to the farmers need and available resources  Zero energy brick cooler
Justification	Appropriate cooling reduces postharvest losses and extends shelf-life, hence the cabbage can be marketed and consumed over a long period and distances. The technology can be used by off-the grid farmers since it does not require any form of power.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, green grocers, processors, household consumers, extension

	workers
Approaches used in dissemination	On-farm and on-station demonstrations, agricultural exhibitions, field days agricultural shows, extension officers, mass media – agricultural programs promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• Use of locally available materials to construct the coolers • Funding to promote the coolers • Formation of marketing groups that would construct the coolers communally • County and Central Government support • Well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the cabbage • Scientists and agricultural extension workers- to provide farmers with knowledge on ZECC • Market players to create a demand and, therefore, increase area production • 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	Embu, Kirinyaga, Kiambu, Machakos
Counties where TIMP will be up scaled	Machakos, Uasin Giishu, Tharaka nithi
Challenges in dissemination	Lack of knowledge on Zero Energy Brick Cooler Lack of starter capital to construct the cooler
Suggestions for addressing the challenges	• Awareness creation and capacity building about the technology to farmers and traders • Avail appropriate financing
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on repair and maintenance of the coolers
Social, environmental, policy and market conditions necessary for development and up scaling	• The sand should be continuously moist. Cooling is more effective in dry and windy environment • Ability of farmers to practice collective marketing of cabbage • Proper linkages between industry, farmer cooperatives, local and regional markets, and bulk purchases • Existing and new export markets are developed and maintained • Policies to encourage cold chain in horticulture sector are implemented. • Favourable policy, encouraging better prices for properly-preserved cabbage
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost, approximately KES 100,000/-
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge on the zero energy brick cooler technology • Women and youth have limited access to education, training and extension services than men • Women and youth have less access to credit to purchase the technology

	than men
Gender related opportunities	• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • 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 • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Kirinyaga, Embu, etc. have used the technology to reduce losses and extend shelf-life, hence the marketing time for the vegetables.
Application guidelines for users	Wayua, F. Ndambuki, J., Ochieng, V. and Wasilwa, L. (2021). Zero Energy Cool Chamber. KALRO/KCSAP Programme Factsheet. September 2021
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALFC, NGOs, CBOs

Research gaps

Validate the technology in different cabbage growing areas

Research on innovative investment options for farmers and groups.

2.8.4 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 cabbages
What is it? (TIMP description)	It is a low cost postharvest temperature management that improves the shelf life of fruits and vegetables using less cost The CoolBotTM™ 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

 CoolBot™	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	CoolBotTM™ 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, aggregators, traders, exporters, processors, household consumers
Approaches used in dissemination	On-farm and on-station demonstrations, agricultural exhibitions, field days Agricultural shows, extension officers, mass media – agricultural programs, promotional materials (posters/brochures/leaflets, manuals), exposure tours to pack houses and collection centres.
Critical/essential factors for successful promotion	• Use of locally available materials to construct the coolers • Funding to promote the coolers • Formation of marketing groups that would construct the coolers communally • County and Central Government support • Well organized farmer groups and networks, increase postharvest training and direct farmer outreach
Partners/stakeholders for scaling up and their roles	Farmers groups to be trained in postharvest handling of cabbage 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	-Machakos, Uasin Gishu, Kericho, Tharaka Nithi
Challenges in dissemination	Lack of knowledge on the technology and the benefits of cooling cabbages 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	• The CoolBot™ can be solar powered, hence ideal in areas with good amount of solar radiation • Ability of farmers to practice collective marketing of cabbages • Proper linkages between industry, farmer cooperatives, local and regional markets, and bulk purchases

	• Existing and new export markets are developed and maintained • Policies to encourage cold chain in horticulture sector are implemented. • Favourable policy, encouraging better prices for properly-preserved cabbages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	CoolBotTM™ (US$ 300)/(Ksh 40,0000) Air conditioner Insulated room Monthly electricity costs
Estimated returns	Increased income. Farmers can store cabbages to sell in the off-season when prices are higher. Improved cold storage facilities will stabilize cabbage 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 scaling up	• Women have less access to information, technology and knowledge on the Evaporative charcoal cooler technology • Women and youth have limited access to education, training and extension services than men • Women and youth have less access to credit to purchase the technology than men
Gender related opportunities	• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge on the CoolBot™ cold storage technology • Women and youth have less access to credit to purchase the technology than men • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Adoption of the TIMPs means reduced losses, hence more cabbage available for consumption and sale. There will be more income for the farmers (VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	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 produce 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 guidelines for users	Wayua, F. Ndambuki, J., Ochieng, V. and Wasilwa, L. (2021). CoolBot™. KALRO/KCSAP Programme Factsheet. September 2021
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale

	Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the CoolBot^{TM}.

Gross margins of the CoolBot^{TM}

2.8.5 TIMP Name	**Wakati^{TM} 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 cabbages
What is it? (TIMP description)  *source: Internet*	Wakati^{TM} 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 at one corner. The fan is placed in 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^{TM} 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	On farm and on station demonstrations, agricultural exhibitions, agricultural shows, Mass media – Agricultural programs, Promotional materials (posters/brochures/leaflets, manuals), exposure tours
Critical/essential factors for successful promotion	• Use of locally available materials to construct the coolers • Funding to promote the coolers
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^{TM}Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up-scaled	Machakos, Uasin Gishu, Kericho, Tharaka Nithi
Challenges in dissemination	Lack of knowledge on the technology and the benefits of cooing cabbages. Limited awareness of the technology by farmers Inadequate funds to install the Wakati^{TM}
Suggestions for addressing	Awareness creation about the technology to farmers and traders - Capacity

the challenges	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	Need to continue capacity building of the farmers and users on construction, repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	The optimal use of Wakati™ 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. To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the Wakati™
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	• Women have less access to information, technology and knowledge on the Wakati™ technology • Women and youth have limited access to education, training and extension services than men Women and youth have less access to credit to purchase the technology than men
Gender related opportunities	• The TIMP increases farm income through reduction of harvest losses by pre-cooling the produce. Women can capitalize on this aspect of cabbage production to reduce harvest losses Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge on the Wakati™ technology • Women and youth have less access to credit to purchase the technology than men • 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. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. have adopted the technology
Application guidelines for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Masinde, A.A.O., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research**)**	Requires validation

G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

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

2.8.6 TIMP Name	Modified Atmosphere Packaging of Cabbage (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 owing to limited knowledge on appropriate packaging of cabbage
What is it? (TIMP description)	Xtend® bags are modified atmosphere bags with 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 cabbage for between 5-7 days.  Modified Atmosphere packaging of cabbage
Justification	The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of cabbage 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	Funding to promote the Xtend® bag packaging
Partners/stakeholders for scaling up and their roles	Farmers groups to be trained in postharvest handling of the cabbages Scientists and agricultural extension workers- to provide farmers with knowhow on modified atmosphere package Technology
C: Current situation and future scaling up	

Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up-scaled	Machakos, Uasin Gishu, Kericho, Tharaka Nithi
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	• Need to continue capacity building of the farmers and users on modified atmosphere packaging of cabbage. • Need to avail the packaging bags close to farmers.
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 modified atmosphere packaging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Pack of 10 bags (medium size) costs USD 5.
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge on the Xtend® bags technology • Women and youth have limited access to education, training and extension services than men • Women and youth have less access to credit to purchase the technology than men
Gender related opportunities	• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances • The Xtend® bags increase farm income through reduction of harvest losses by pre-cooling the produce. Women can capitalize on this aspect of cabbage production to reduce harvest losses
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge on the Xtend® bags technology • Women and youth have less access to credit to purchase the technology than men • 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. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.

Application guidelines for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Masinde, A.A.O., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
F: Status of TIMP readiness (Ready for up-scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps
Gross margin of modified atmosphere packaging
Comparing MAP with other packaging in terms of shelf life

2.9 Cabbage Value Addition

2.9.1 TIMP name	**Cabbage flour**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of cabbage
What is it? (TIMP description)	Flour prepared from milling dried cabbage   Cabbage flour
Justification	There is over dependence of maize and wheat flour that are not fortified for enhancement of their nutritional value. Cabbage flour can be used to blending these sources of flour enhancing the nutritional value since it is rich in vitamins, minerals and dietary fiber among others.

	Diversification of cabbage food products will enhance consumption of cabbage, and demand thus spur increased production. Cabbage can be processed to make flour, which can either be fortified or blended with wheat to make various products including *mandazi, bread, cake, cookies etc*. Use of cabbage flour will improve the human nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, small-scale processors / entrepreneurs, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials (posters/brochures/ leaflets), exposure tours to processing groups
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality Cabbage, availability of quality standards
Partners/stakeholders for scaling up and their roles	Farmer groups – provide land for establishment of small-scale cabbage processing facility Extension service providers (Public and private) to help in the dissemination KALRO – will train trainers and provide technical backstopping on dissemination of cabbage flour production technology KEBS – Standards formulation for cabbage flour, certification of private cabbage flour processors Private sector processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage flour National and County governments Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of the technology by farmers Majority of the Kenyan population only recognizing maize as the staple food Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities
Suggestions for addressing the challenges	Awareness creation about the product to the government agencies, farmers, and traders Capacity building of farmers on how to use the products Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for its widespread use Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like cabbage, focusing on the nutritional quality of cabbage (gluten-free and rich in minerals). Working with KEBS to develop standards for cabbage flour Linking farmers to credit facility providers to get capital to engage in cabbage flour production agribusiness.
Lessons learned in up	• It would be good for farmer tours to processing groups to expose farmers

scaling, if any	to cabbage flour production technology • Adequate capacity building is essential for technology adoption
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need to develop quality standards for cabbage flour to propel its commercialization Nutrition education and changing consumer behavior to incorporate cabbage flour Polices on composite fours are developed and / or implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Milling equipment and infrastructure
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of cabbage
Gender issues and concerns in development, dissemination adoption and scaling up	• Women may have less access to information, technology and knowledge on the technology. • Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	• Employment opportunities exist for women in making the cabbage flour for both home consumption for sale.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in making cabbage flour for both home consumption and for sale.
E: Case studies/profiles of success stories	
Success stories	Experiences from European countries
Application guidelines for users	Ndambuki, J., Wayua, F., Wasike V. and Wasilwa, L. (2021). Cabbage flour. KALRO/ KCSAP Value Addition Programme Factsheet No.
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Characterizing the various cabbage varieties for their cabbage flour yield production potential
Research on flour conversion ratio (Cabbage to flour conversion ratio)
Research on nutritional content of cabbage flour and the derived value added cabbage -based products
Research on technological and food processing properties of cabbage flour (water absorption capacity, rheological properties, pasting characteristics, etc.)
Conduct business and economic analyses of cabbage flour production and target markets for cabbage flour
Research on options for commercializing the product – i.e. linking with industry / off-takers (food processors, hotels, supermarkets, etc.)
Development of quality standards for cabbage flour and cabbage flour based products

2.9.2 TIMP name	**Solar drying of cabbage (DeHyTray)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Short shelf life of cabbage
What is it? (TIMP description)	The **"DEHYTRAY"** a simple solar tray for hygienic solar drying of cabbages and other high value horticultural crops. The tray measures about 0.4m width, 0.85m long and 0.13m high. The tray is black to absorb and radiate solar energy, and has temperature and relative humidity control vent. The Dehytray is used in dehydrating cabbages to be used in soups, stir-fry throughout the seasons by use of solar energy.  Dehytray solar dryer
Justification	Short shelf life of cabbages due to high perishability. Drying surplus cabbages for future use (preservation by drying). Dried cabbage put in an airtight container or sealed bags can be conditioned for a long time without going bad.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	Practical demonstrations, field days, Agriculture shows, Farmer to farmer communication
Critical/essential factors for successful promotion	Successful in areas with good solar radiation Local artisans can be trained on fabrication, repair and maintenance Ensuring sanitary condition when handling cabbages for drying
Partners/stakeholders for scaling up and their roles	Famers- to adopt the technology for usage Artisans - to fabricate the solar dryers, Dehytray Workers- to provide farmers with knowhow on solar drying and utilization of solar dried cabbages
C: Current situation and future scaling up	
Counties where already	Nakuru, Uasin Gishu, Trans Nzoia, Nandi and Bungoma

promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
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	• Extension training and regular monitoring are essential. • Availability of Dehytray within easy reach of farmers
Social, environmental, policy and market conditions necessary for development and up scaling	• Use locally available materials to fabricate the driers • Solar dried cabbages can be used in the dry season • Environmentally friendly resilient and climate smart. The technology uses solar energy and does not negatively affect the environment. • The technology works best in dry weather (high temperatures and low relative humidity) • Markets for solar dried vegetables sustained and expanded
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Dehytray costs approximately KES 10,000/-
Estimated returns	Increased income, nutrition; Reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge on the technology • Women perform most of the crops value adding activities therefore the Dehytray will ease their work • Women and youth have limited access to education, training and extension services than men • Women and youths may have less access to credit to purchase the solar bubble drier
Gender related opportunities	• Employment opportunities exist for women in performing the task • Affirmative action opportunities such as women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • 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 • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in performing the task
E: Case studies/profiles of success stories	
Success stories	Farmers in Muringa, Nairobi and Kilifi have adopted the technology
Application guidelines for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Masinde, A.A.O., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management

	Practices. KALRO / KCSAP project, February 2021.
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Farmers in Murang'a, Nairobi and Kilifi have adopted the technology
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

2.9.3 TIMP name	**Cabbage Juice**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• Lack of information on the type of food that can be made from cabbage. • Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)	Juice prepared from ripe and firm cabbages  Cabbage juice
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with sweet taste, fine flavor and texture can be processed into juice for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, small-scale processors, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate

	affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage juice production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage juice production. KEBS – Standards formulation for cabbage juice; certification of private cabbage juice processors Private sector processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage juice
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women may have less access to information, technology and knowledge on the technology. • Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	• Employment opportunities exist for women in making the melon wine for both home consumption for sale.

VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in making the melon wine for both home consumption and for sale.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde A.A.O and Wasilwa, L. (2021). Cabbage juice. KALRO / KCSAP Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research GAPs
Characterize different cabbage varieties for their nutritional composition and suitability in processing various value-added products (flour, pickle, juice)

2.9.4 TIMP name	**Prickled cabbage**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of cabbage
What is it? (TIMP description)	Pickle prepared from mature cabbages which are sliced into equal sizes and packed in containers filled with white vinegar
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into pickle for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits,

	leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage juice production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage pickle production. KEBS – Standards formulation for cabbage pickle; certification of private cabbage pickle processors Private sector processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage pickle
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption	• Women may have less access to information, technology and knowledge on the technology.

and scaling up	• Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	• Employment opportunities exist for women in making the prickled cabbage for both home consumption for sale.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in making the prickled cabbage for both home consumption and for sale
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Cabbage pickle production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Characterizing the various cabbage varieties for their cabbage pickle production potential (for example, which variety produces the best pickle)?

Optimizing the pickle production procedures

2.9.5 TIMP name	**Cabbage Soup**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• Lack of information on the type of food that can be made from cabbage. • Diversifying cabbage food to different community so to provide them with choices • Limited knowledge in providing new products to access fast growing market diversification

What is it? (TIMP description)  Cabbage soup	Soups are prepared from mature cabbages. It's made by shredding of the cabbage and frying using tomatoes, oils and beans.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into soup for both household use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, small-scale processors / entrepreneurs, industrial and households
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions.
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on cabbage soup processing. They will also offer advice and collect information on the uptake and practice on the technology • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage soup
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers

Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women may have less access to information, technology and knowledge on the technology. • Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	• Employment opportunities exist for women in making the cabbage soup for both home consumption for sale.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in making the cabbage soup for both home consumption and for sale
E: Case studies/profiles of success stories	
Success stories	Success stories from countries in Europe and America
Application guidelines for users	Cabbage soup production leaflets and manuals
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 Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

2.9.6 TIMP name	**Fermented cabbage**
Category (i.e. technology,	Innovation

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Limited diversity of cabbage products
What is it? (TIMP description)	Fermented cabbage is prepared from mature cabbage by fermenting cabbage in brine for seven days.   Fermented cabbage
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into fermented cabbage for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, small-scale processors / entrepreneurs, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on fermented cabbage production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of fermented cabbage production. KEBS – Standards formulation for fermented cabbage; certification of private fermented cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the fermented cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	

Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women may have less access to information, technology and knowledge on the technology. • Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	• Employment opportunities exist for women in making the fermented cabbage for both home consumption for sale.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunities exist for some VMGs such as women in making the fermented cabbage for both home consumption and for sale
E: Case studies/profiles of success stories	

Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde, A.A.O and Wasilwa, L. (2021). Fermented cabbage. KALRO/ KCSAP Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Characterizing the various cabbage varieties for their fermented cabbage production potential (for example, which variety produces the best fermented cabbage)

2.9.7 TIMP name	**Canning**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)	Canned cabbage is prepared from mature cabbage. It's made by cutting the cabbage into desired shapes, boiling for three minutes, then packing in hot jars leaving 1 inch head space.   Canned cabbage
Justification	Canning enables long term preservation of cabbage, transportation and use of the product in areas which do not produce it. Cabbage with fine flavor and texture can be processed into canned cabbage for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on canned cabbage production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of canned cabbage production. KEBS – Standards formulation for canned cabbage; certification of private canned cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the canned cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have less access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production use and sale of canned cabbage • Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • 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 • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume canned cabbage
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Canned cabbage production factsheets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research Gaps

Analysis of the nutrient content of the canned cabbage

2.9.8 TIMP name	**Cabbage pancake**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)	Cabbage pancake is a thin, flat cake of batter, fried on both sides in a pan and typically rolled up with a sweet or savory filling by use of wheat or

 Cabbage pancake	blending it with others flours or mixing with sliced fresh vegetables like cabbage. It's made by mixing the flour with sliced cabbage, eggs and water, then blending the mixture, This is fried on a pan and consumed with beverage or stew.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into cabbage pancake for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage pancake production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage pancake production. KEBS – Standards formulation for cabbage pancake; certification of private cabbage pancake processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage pancake
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination

	postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have less access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production use and sale of cabbage pancake • Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • 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 • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage pancake
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde, A.A.O and Wasilwa, L. (2021). Cabbage pancake. KALRO/Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa

Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research Gaps

Providing data on gross margin and market demand for cabbage pancake

2.9.9 TIMP name	**Buttered cabbage**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Buttered cabbage	Cabbage butter is boiled cabbage in butter. It's made by frying butter with water in sauce pan then adding shredded cabbage and boiling until the water dries. It can be consumed with chapatti, pancake or githeri.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into cabbage pancake for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on buttered cabbage production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of buttered cabbage production. KEBS – Standards formulation for fermented cabbage; certification of private buttered cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide

	markets for the buttered cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have less access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production use and sale of battered cabbage • Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • 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 • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume battered cabbage

E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde, A.A.O and Wasilwa, L. (2021). Buttered cabbage. KALRO/ KCSAP Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Commercialization and gross margin of buttered cabbage

2.9.10 TIMP name	Cabbage Kimchi
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• Lack of information on the type of food that can be made from cabbage. • Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Cabbage kimchi	Kimchi is a tasty cabbage. It's made by making a spiced paste which is fermented for 5 days. After fermentation it's refrigerated for two weeks. It can be consumed as a snack.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production. Cabbage with fine flavor and texture can be processed into cabbage kimchi for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of

	high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage kimchi production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage kimchi production. KEBS – Standards formulation for cabbage kimchi; certification of private buttered cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage kimchi
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
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 have less access to information, technology and knowledge • Women and youth have less access to education, training and extension services than men
Gender related	Women and youth stand to benefit in production use and sale of cabbage

opportunities	Kimchi Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage Kimchi
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Cabbage kimchi production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research Gaps

Market demand of cabbage Kimchi

2.9.11 TIMP name	**Cabbage Crackie**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description) 	Cabbage crackie is an extruded deep fried snack made from cabbage-wheat flour dough passed through a noodle machine

Cabbage crackie	
Justification	The narrow range of cabbage products calls for diversification. Processing cabbage to crackie will diversify cabbage use and enhance consumption. This will enhance demand and thus spur increased production of cabbage
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage crackie production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage crackie production. KEBS – Standards formulation for cabbage crackie; certification of private cabbage crackie processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage crackie
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental,	Target women and youth as entrepreneurs in society who are the major

policy and market conditions necessary for development and up scaling	adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have less access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production use and sale of cabbage crackie • Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage crackie
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde, A. and Wasilwa, L. (2021). Cabbage crackie. KALRO/Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua, Anastacia Masinde and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research Gaps

Cabbage varieties best for crackie production

2.9.12 TIMP name	**Cabbage Cakes**
Category (i.e. technology, innovation or management	Innovation

practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Cabbage cake	A snack food product made from cabbage-wheat composite flour.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production of cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage cake production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage cake production. KEBS – Standards formulation for cabbage cake; certification of private cabbage cake processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage cake
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products

Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Women have less access to information, technology and knowledge Women and youth have less access to education, training and extension services than men
Gender related opportunities	Women and youth stand to benefit in production use and sale of cabbage cake Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage cake
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Ndambuki, J., Wayua, F., Masinde, A. and Wasilwa, L. (2021). Cabbage cake. KALRO/Value Addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	

Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua, Anastacia Masinde and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Nutritional analysis of cabbage cake

2.9.13 TIMP name	**Cabbage Mandazi**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Cabbage Mandazi	A snack food product made from cabbage-wheat composite flour.
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production of cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on cabbage mandazi production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of cabbage mandazi production. KEBS – Standards formulation for cabbage mandazi; certification of private cabbage mandazi processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the cabbage mandazi

C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 10 per piece
Estimated returns	Increased income
Gender issues and concerns in development, dissemination adoption and scaling up	Women have less access to information, technology and knowledge Women and youth have less access to education, training and extension services than men
Gender related opportunities	Women and youth stand to benefit in production use and sale of cabbage mandazi Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage mandazi

E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Cabbage mandazi production factsheets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua, Anastacia Masinde and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Gross margin and market demand for cabbage mandazi

2.9.14 TIMP name	Cabbage Flake
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Flaked cabbage	A snack food product made from dehydrated sliced cabbage
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production of cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards;

	Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on flaked cabbage production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of flaked cabbage production. KEBS – Standards formulation for flaked cabbage; certification of private flaked cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the flaked cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Women have less access to information, technology and knowledge Women and youth have less access to education, training and extension services than men Men dominant most decisions at the household and community levels
Gender related opportunities	Women and youth stand to benefit in production use and sale of cabbage flake

	Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage flakes
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Flaked cabbage processing leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua, Anastacia Masinde and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gap

Gross margin and market demand for flaked cabbage

2.9.15 TIMP name	**Cabbage Salads**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from cabbage. Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description) 	A cold dish of various mixtures of raw or cooked vegetables, usually seasoned with oil, vinegar or other dressing. Usually consumed with meals.

Cabbage salad	
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production of cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on salad cabbage production. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of salad cabbage production. KEBS – Standards formulation for salad cabbage; certification of private salad cabbage processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the salad cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for

conditions necessary for development and up scaling	the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Women have less access to information, technology and knowledge Women and youth have less access to education, training and extension services than men
Gender related opportunities	Women and youth stand to benefit in production use and sale of cabbage salads Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume cabbage salads
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Salad cabbage production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua, Anastacia Masinde and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research Gaps

Gross margin and market demand of salad cabbage

2.9.16 TIMP name	**Steamed cabbage**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• Lack of information on the type of food that can be made from

	cabbage. • Diversifying cabbage food to different community so to provide them choices
What is it? (TIMP description)  Steamed cabbage	This is a sliced cabbage deeper in boiling water for 3-5 minutes. It is consumed with seasoning, stew
Justification	Diversification of cabbage food products will enhance consumption of cabbage, enhance demand and thus spur increased production of cabbage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration field days shows exhibitions Farmer Field Schools Innovation Platforms (IPs) farmer exchange visits TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality cabbages, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process cabbage into various products; The government should facilitate affordable credit to empower farmers take up cabbage agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on steamed cabbage processing. They will also offer advice and collect information on the uptake and practice on the technology KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of steamed cabbage processing. Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the steamed cabbage
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up-scaled	Nyeri, Murang'a, Kiambu
Challenges in dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level.

	Difficulty in acquiring certificates from regulatory authorities, lack of credit facilities, limited consumer awareness of value-added cabbage products
Suggestions for addressing the challenges	Awareness creation about the product to farmers, consumers and other value chain actors. Capacity building of farmers on how to prepare the product - Information dissemination postharvest handling, value addition, and nutritional attributes of the product Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added cabbage products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up cabbage agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Women have less access to information, technology and knowledge Women and youth have less access to education, training and extension services than men Men dominant most decisions at the household and community levels
Gender related opportunities	Women and youth stand to benefit in production use and sale of steamed cabbage Value addition lead to increased financial value to the raw product and has the effect of improving incomes and livelihoods of those participating especially women
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to productive resources such as land, credit, and quality seed 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 There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume steamed cabbage
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Steamed production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires	Requires validation

validation, 3-requires further research)	
G: Contacts	
Contacts	The Centre Director, KALRO-Kitale, P.O. Box 450-30200. Kitale Email: director.fcri@kalro.org, Phone: +254-020 350 9161
Lead organization and scientists	KALRO, James Ndambuki, Francis Wayua, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoAFLC, NGOs, CBOs

Research gaps

Gross margins to enhance commercialization

2.10 Mechanization of Cabbage Production Activities

2.10.1 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 a commercialized Cabbage commodity
	  • Difficult to prepare a uniform fine tilth seedbed manually
	  • Delayed operation lead to late planting
	  • High cost of manual labour

	•
 What is it? (TIMP description) (Source; Nasirembe, AMRI Katumani 2021)	A Power tiller is a low powered two-wheeled agricultural implement, also referred to as a walking tractor 8-16hp that can be fitted with a rotary tiller, disk harrow, mouldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete one hectare per day by one operator in about two hours though the machine could do more with a different operator. This will vary depending on the climatic conditions, soil types, soil moisture content, operator stamina and experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation, sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for transporting produce. A

	power Tiller is ideal where the land size is small. Farm sizes less than one hectare may limit maneuverability of conventional tractors while manual labour is slow and costly.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
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	Trans Nzoia
Counties where TIMP will be up scaled	West Pokot, Bungoma
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for machines
Suggestions for addressing the challenges	• Acquisition of the machines • Facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	5ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the power tiller. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.

Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce the drudgery of work of the various gender categories such as women. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals • Pamphlets
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,W, 0733812953

Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.10.2 TIMP Name	**Wheeled Tractor 50Hp**
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 a commercialized Cabbage commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source; Nasirembe, ATDC Soakage 2021)	A small sized, 4 wheeled tractors is a low powered agricultural implement of 40-55hp that can be fitted with a rotary tiller, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 4 hectares per day by one operator but can have two operators to run another 8 hours of 4 hectares coming to 8 per day. This will vary depending on the climatic conditions, soil types, soil moisture content and operator experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation soil, sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for planting through a power take off device and transporting produce. Farm sizes less than one hectare may limit maneuverability of conventional tractors and manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers, extension service providers, Universities and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery dealers NGO supporting farmers for dissemination

C: Current situation and future scaling up	
Counties where already promoted if any	Trans Nzoia
Counties where TIMP will be up scaled	Bungoma, West Pokot Uasin Gishu
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the tractors • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1,780,000,00
Estimated returns	3ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• Introduction of this labor intensive implement will reduce the work burden of men and women who perform the task of ploughing • Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the wheeled tractor. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development,	• Introduction of the labor intensive implement

dissemination, adoption and scaling up	will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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, finger millet 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**)**	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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.10.3 TIMP Name	**Moldboard plough**
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 a commercialized Cabbage commodity • Difficult to prepare a uniform fine tilth seedbed

	manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source; https://www.google.com/url?sa=i&url=https%3A%2F%2Fnewandusedtractors.com%2Fproduct%2Fmould-board-ploughmould-board-plough-for sale%2F&psig=AOvVaw2VjunfG8n0BKdaMlGEF9RX&ust=1666167134976000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCPjMkLSq6foCFQAAAAAdAAAAABAE)	Moldboard plough is an agricultural implement and is generally considered to be the important tillage implement. Moldboard 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.
Justification	High Efficiency. When well-adjusted, the plough automatically seeks the desired depth. It is Versatility. The various models have different features that enable high efficiency in preparation of the land. Weed Control. Pest Control. Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
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	Trans Nzoia
Counties where TIMP will be up scaled	Bungoma, West Pokot, Uasin Gishu
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural

	production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 550,000.00
Estimated returns	3ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• Introduction of this labor intensive implement will reduce the work burden of men and women who perform the task of ploughing • Women and youth have limited access credit to purchase the mouldboard Plough. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of some VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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, finger millet 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**)**	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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.10.4 TIMP Name	**Disc Harrow**
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 a commercialized Cabbage commodity • Difficult to prepare a uniform fine tilth seedbed 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;	It is an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up clods, remove weeds, and cover seed and is a cultivating tool set with used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.

https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.svg)	
Justification	Creating of a crumbly layer for planting is tedious. It is not possible to manually protect the soil surface from rapid drying. Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken. Manual operation will reduce microbiological processes in the soil. Manual land harrowing Improving of nutrient availability to plants.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
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	Trans Nzoia
Counties where TIMP will be up scaled	Bungoma, West Pokot, Uasin Gishu
Challenges in dissemination	• Lack of machines • Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Men perform the land preparation activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit

	to purchase the disk harrow implement. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce labor burden of some VMGs who usually perform the task. • VMGs have limited access to credit to purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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, finger millet 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**)**	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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.10.5 TIMP Name	Multi-function seedbed ridging machine
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Poor drainage during plant growth • Insufficient root growth • Poor root aeration • Poor infiltration
What is it? (TIMP description)  (Source:https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.ca%2Fpin%2Fhot-item-farm-equipment-bed-shapers-ridging-plough-for-cassava-planting--729231364655320466%2F&psig=AOvVaw07ThfN2eJvsQLDNITViRh5&ust=1666212915616000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCMj45_nU6voCFQAAAAAdAAAAABAE)	Bed shapers with shaping disks form new beds from flat ground. One-pass "quick" bedding is conventional in easy-working soils. First prepare soil to seedbed condition with conventional tillage equipment. One-pass bedding can be done equally well in many soil types provided soil is tilled equally well. Needed tractor power primarily depends on bed height. A rugged, versatile, user-friendly equipment, we provide know-how to allow growers in all regions to take advantage of raised beds to grow better crops. Bed Shapers intelligently adapt to the local environment, local soil types and local tillage practices
Justification	Machine seedbed ridging is uniform in tilth and height. It saves time in ridge formation of seedbeds, cheaper and enhances labour productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
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	Non
Counties where TIMP will be up scaled	Trans Nzoia
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 • Encourage entrepreneurs to invest in equipment hire service
Lessons learned in up scaling if any	• Low scale of seedling production does not encourage use of a machine • There is lack of awareness about the machine • Has capacity to make a large number of beds within a short time
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. • Favourable on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	325,000 KES per unit
Estimated returns	2ha per day
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	• Women perform most of the crops activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access to credit to purchase the implement. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	• The multi-function seedbed ridging machine will reduce the labour burden of some of the VMGs such as women and those abled differently. • VMGs have limited access to credit to purchase the implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in the

	development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
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 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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.10.6 TIMP Name	**Cabbage direct Planter**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seed placement • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source:https://www.google.com/url?sa=i&url=https%3A%2F%2Faicrp.icar.gov.in%2Ffim%2Fsalie	A Cabbage planter is a device used in agriculture that opens furrows, meters, sows cabbage, seed by positioning them in the soil and burying them to a specific depth without forming a ridge along seed rows. The Cabbage planter sows seed at the proper seeding rate and depth, ensuring that the seeds are covered by soil. This management practice skips the nursery preplanning procedure.

nt-achievements%2Fsowing-and-planting-equipment%2F2%2F&psig=AOvVaw2Tr2sh_MS4IkIZ9ivm6m9v&ust=1666258163904000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCPDW9sH96_oCFQAAAAAdAAAAABAM)	
Justification	• Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Cabbage seed is small making planting depth critical and difficult to attain when manually done and seed shallowly planted will germinate with poor yields • Raw planting increases yields, easy to manage weeds and pests, and more importantly timely uniform and low labour requirement,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
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	Non
Counties where TIMP will be up scaled	Trans Nzoia
Challenges in dissemination	• Lack of machines • Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	KES 880,000
Estimated returns	10ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the planting activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the planter. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase the implement. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
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, finger millet 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, Nasirembe W. W.

2.10.7 TIMP Name	**Seedling tray planter**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	• Tedious to plant in the trays manually • Manual planting is difficult to calibrate and may allow planting more than one seed in a hole • Manual seed try planting is time wasting
 What is it? (TIMP description) (Source: https://s.alicdn.com/@sc04/kf/Hb4c358ebe1574892a7302c3e5c4f459cA.jpg_960x960.jpg)	For sowing seed that needs to be transplanted the machine is able to plant in trays without cells / box seeding, constantly feeding of the seed Speed of seed supply is adjustable; it has a belt of 400 cm long x 40 cm wide with brush for cleaning the top of the trays. The speed of the vibrating bowls is adjustable. Also you can adjust on the top side of the bowl the size of the seeds. The seeds fall down in a pipe that distributes the seeds over the output hoses.
Justification	• Manual Cabbage seed tray planting can cover low acreage within a stipulated time and may delay due to bad weather • Manual planting labour dependency and require 20 people per hectare while a planter will require only 1 for the same time. • A part from lack of harvesting labour cost is saved by at least 70 percent
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
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	Non
Counties where TIMP will be up scaled	Baringo
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,

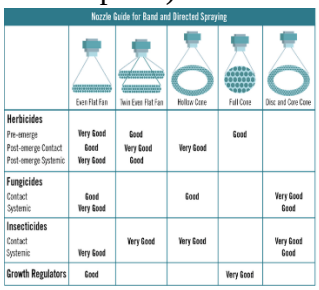
	yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Favourable on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 360,000.00
Estimated returns	KES 200.00/tray (50-288cells)
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	• Women perform most of the planting activities; therefore, the tray planter will reduce their drudgery of work. • Women and youth have limited access credit to purchase the seedling tray planter. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
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**)**	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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators
VMG related opportunities	Can create employment for VMG at local level

2.10.8 TIMP Name	**Cabbage Trans planter**
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 seedling placement • Inconsistent planting depth and soil firming • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source: https://www.google.com/url?sa=i&url=https%3A%2F%2Fbrandsequipment.com%2Fferrari.php&psig=AOvVaw2aigYdP2Ktqyiyw_GkXk49&ust=1666271796494000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCJDdqKaw7PoCFQAAAAAdAAAAABAY)	A Cabbage seedling trans planter is a device used in agriculture that opens furrows meters, sow Cabbage seedlings by positioning them in the soil and burying them to a specific depth without forming a ridge along the seed row and firming them. The Cabbage trans planter places seedlings at the proper seeding spacing and depth.
Justification	• Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Cabbage seedling is small making planting depth critical and difficult to attain when manually done and seedling shallowly planted will fail to pick • Raw planting increases yields, easy to manage weeds and pests, and more importantly timely uniform and low labour requirement,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
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	Non
Counties where TIMP will be up scaled	Trans Nzoia
Challenges in dissemination	• Lack of facilitation for demonstration

	• High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Facilitate demonstrations • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 780,000
Estimated returns	2ha per day
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the transplanting activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the implement. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
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	• VMGs have limited access to credit to purchase the implement. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Can create employment for VMG at local level
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, finger millet 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**)**	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, Nasirembe W. W.
Partner organizations	Local dealers

2.10.9 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 manual spraying of Cabbage
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, Post-emerge Contact, Post-emerge Systemic): Very Good, Good, Very Good / Good, Very Good, Good / Very Good / Good / — Fungicides (Contact, Systemic): Good, Very Good / — / Good / — / Very Good, Good Insecticides (Contact, Systemic): Very Good / Very Good / Very Good / — / Very Good, Good Growth Regulators: Good / — / — / Very Good / — (Source; Nasirembe, Katumani, 2021) (Source:https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.potatogrower.com%2F2018%2F06%2Fselecting-the-right-nozzles-for&psig=AOvVaw0yoH6Ga98Gjl0Y1Pk_1-mu&ust=1666185100752000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCIC716rt6foCFQAAAAAdAAAAABAE)	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 harbor 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.
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Cabbage forms a canopy, broad leafed weeds compete with Cabbage seedling for nutrients and light greatly reducing their yield. Manual sprayer is labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training

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	Trans Nzoia
Counties where TIMP will be up scaled	Trans Nzoia, Bungoma, Uasin Gishu
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
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	KES 55,000.00
Estimated returns	2ha per day
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	• Men perform most of the spraying activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the motorized sprayer. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce men's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to

	purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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, finger millet 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**)**	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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators
2.10.10 TIMP Name	**Harvesting**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Late harvesting • Untimely harvesting • High cost of labour • Poor quality of produce due to injury • Loses due to part harvesting when workers get fatigued and some harvested Cabbages are left on the farm
What is it? (TIMP description)	A Cabbage harvester is a machine that harvests Cabbages.

 (Source:https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DyFiZYPagYJc&psig=AOvVaw2tT7tiVlvVHuUFj2QsTvDv&ust=1666273380263000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCJim4pm27PoCFQAAAAAdAAAAABAE)	It works by lifting the Cabbages from the bed using a share. Soil and crop are transferred onto a series of webs where the loose soil is sieved out. The Cabbages are moved towards the back of the harvester on to a separation unit and then (on manned machines) to a picking table where people pick out the stones, clods, and haulms (stems or stalks) by hand. The Cabbages then go on to a side elevator and into a trailer or a Cabbage box.
Justification	• Manual Cabbage harvesting can cover low acreage within a stipulated time and may delay bad weather • Manual harvesting is labour dependency and require 20 people per hectare while a Cabbage harvester will require only 3. • A part from lack of labour harvesting cost is saved by at least 60 percent more than machine
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Cabbage Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
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	Non
Counties where TIMP will be up scaled	Trans Nzoia
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
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	Cabbage harvester 125,000 KES per unit
Estimated returns	500 Kg/ hour,
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Cabbage Harvester designed for easy start and operation. Men have been drawn to Cabbage planting by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet
Estimated returns	Not yet
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women perform most of the harvesting activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the harvesting machine. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed youth males in operating the implement.

	• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
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**)**	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,
Partner organizations	Local Fabricators
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,W, 0733812953
Partner organizations	Agricultural machinery dealers, suppliers, parts stockists, Fabricators

2.11 Cabbage Farming Business and Marketing

2.11.1 TIMP Name	**Transformative Model of Cabbage production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Cabbage productivity coupled with low transition of farmers from subsistence to commercial farming leads to poor income generation. In addition seasonality in crop production due to rain fed farming leads to oversupply and deficits in some seasons. Poor distribution of cabbage product leads to high transaction costs and prices This leads to poor farmer-market linkages of Cabbage leading to poor market accessibility and linkages.
What is it? (TIMP description)	Transformative model of in cabbage production involves three levels of shifting. As farmers gain production skills and improved

	access to markets, the production of Cabbage shifts from subsistence, to semi-commercial to fully commercial. An approach to transform smallholder farmers from the use of 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 have led to disorganization in Cabbage business. Due to the disorganization in market-oriented production of Cabbage, smallholder farmers fail to access markets or have limited market linkages. Therefore, the transformative model drives farmers and links them to markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, and Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, and farmers' groups
Critical/essential factors for successful promotion	• Availability of traders and other upstream actors • Acceptance of smallholder farmers to form production and marketing groups • Investments in the production of quality tradable volumes • Acceptance of the Cabbage improved varieties by consumers • Adaptability of the Cabbage varieties • Stable Prices of Cabbage • Availability of storage infrastructure and transport • Continuous market research
Partners/stakeholders for scaling up and their roles	• Farmers – Formation of production groups, investments in Cabbage 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 Cabbage production • Research institutions – Availing improved seeds and knowledge and support through backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Low entrepreneurship skill among actors in cabbage value chain • Disorganization and scattered farmers • Small-scale farming • Seasonality in production • Dependence of rain fad farming • Inadequate information to stakeholders on the Cabbage varieties • Group dynamics • Amounts of seeds of the varieties • Weak or non-existent stakeholder innovation platforms • Consumer acceptance on the new varieties • Prices of the Cabbage varieties

	• Levels of production constraints • Level of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage varieties – Use of promotion channels for instance media and field days • Group dynamics – Capacity building on the group dynamics and management • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Consumer acceptance on the new varieties – Promotion of new Cabbage varieties through field days. • Prices of the Cabbage varieties – Value addition, producer organization, managing costs in production, capacity building on farming as a business • Levels of production constraints – Enhancing adoption of Cabbage TIMPs • Level of policy support – Use of National agricultural strategies. Lobbying for the County support in policy options
Lessons learned in up scaling if any	• High market competition with other Cabbage varieties • Volatility in prices • Agro-ecological zone considerations • The transformative process is constraints by many factors
Social, environmental, policy and market conditions necessary for development and up-scaling	• Changing eating habits • Social conditions – acceptability by the farmers, group dynamics, cultures • 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	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women lack entrepreneurial skills and capacity to engage in the transformative model than men • Women lack basic reading and numeracy skills so they can run their businesses compared with men • Women have less access to market than men
Gender related opportunities	• Opportunities exist for women and youths to venture in the transformative model
VMG issues and concerns in	• VMGs may lack entrepreneurial skills and capacity to engage

development and dissemination, adoption and scaling up	in the transformative model than men • VMGs may lack the business acumen to venture in the transformative model than men compared with men • Women have less access to market than men
VMG related opportunities	• Opportunities exist for some VMGs such as women to venture in transformative
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Efficiency evaluation of the farmer-market linking models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

2.11.2 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	Low Cabbage productivity due to low income which contributes to inaccessibility of improved production inputs. The problem of failure of profitability analysis is common among the smallholder farmers of Cabbage. 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 Cabbage agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain.
Justification	Without profitability analysis, farmers are unable to review the management success and sustainability of the Cabbage farming

	business. It indicates areas of adjustment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, technology developers
Approaches to be used in dissemination	Trainings, factsheets, manuals
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
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Cabbage production and marketing • Volatile prices
	• Defining production programmers of Cabbage • 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 Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production – Developing information hub • Defining production programmers of Cabbage – SWOT analysis • Level of policy support – support in extension services
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with subsistence-oriented production • Environmental conditions – Opportunities degrading natural resource management • Policy conditions – Policy support in opportunities selected
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women are widely discriminated in rural producer organizations that are linked to markets. • Women have limited access to lucrative markets than men.

Gender related opportunities	• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing. • Opportunities exist for unemployed youth in production and marketing through ICT.
VMG related opportunities	• Production opportunities – Cabbage production programme • Profitable opportunities
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)	Budget templates are ready for up-scaling
G: Contacts	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Profitable opportunities

2.11.3 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	Inefficiencies in and lack of cabbage markets is manifested in low cabbage productivity. Lack of market information on outlets and prices also leads to information asymmetric among cabbage value chain actors.
What is it? (TIMP description)	Market research is a practice by farmers to gather market information to help then in business planning and organizing the production.
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 market research provides relevant data to help solve marketing challenges that farmers most likely face in their Farm businesses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Organization of farmers • Formation of market research group or market opportunity group • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	• Farmers – Formation of market opportunity group • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Formation of market opportunity group • Availability of information • Levels of policy support
Suggestions for addressing the	• Disorganization and scattered farmers – Formation of

challenges	producer organization • Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Formation of market opportunity group • Availability of information • Levels of policy support
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with subsistence-oriented production • Environmental conditions – Over-use of cultivated land due to over-production of Cabbage • Policy conditions – Policy support in market opportunity groups
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• High illiteracy levels of women leading to lack of record keeping and poor record keeping.
Gender related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan
VMG issues and concerns in development and dissemination, adoption and scaling up	• Some of the VMGs are illiterate hence cannot keep good records.
VMG related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO
	Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Performance of market opportunity groups
- Sustainability of the market opportunity groups
- Equity distribution in sales and income

2.11.4 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 cabbage aggregation centres due to individual marketing practices leads to low prices and low incomes. Smallholders selling alone leads to lack the big production volume and the bargaining power to command on-time delivery of agricultural inputs at reasonable prices.
What is it? (TIMP description)	Collective marketing is a characteristic of producer organization which is a group of producers formed with an objective of accessing markets and reducing market failures. It is a legal entity established to bring farmers together to benefit from marketing.
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, formation of producer organizations would reduce these constraints.
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	• Availability of County policies • Willingness of farmers • Availability of targeted markets • Availability of agreements
Partners/stakeholders for scaling up and their roles	• Farmers – Members of producer organization • 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	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Cabbage production and marketing

	• Group dynamics • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production organizations • Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production and marketing – Capacity building on sources of information. • Group dynamics – Capacity building • Level of policy support – support in extension services
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with subsistence-oriented production • Environmental conditions – Degradation of natural resources due to over-production • 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	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women are widely discriminated in rural producer organizations • Women also have limited participation and influence in rural producer organizations • Socio-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate • Limited access to assets, resources and services, required to join producer groups • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are widely discriminated in rural producer organizations • VMGs also have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed youth in production and marketing through ICT
E: Case studies/profiles of success stories	
Success stories from previous	None

similar projects	
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	Requires validation
research)	
G: Contacts	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Performance of producer organizations
- Production efficiency in Cabbage production due to the formation of producer organizations
- Equity distribution in income

2.11.5 TIMP Name	**Marketing innovation model**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor marketing system is a major challenge in cabbage value chain development. As farmers produce and market Cabbage, 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)	The marketing innovation model is characterized by the entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit. Some of the innovations include identification of the opportunities and strengths
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of Cabbage the market outlook will be narrow. Without entrepreneur skills, farmers will remain at subsistence farming. The characteristics of subsistence farmers are production for self-sufficiency and limited incentive for the market, limited participation in input and output markets, limited investment in inputs and technology, reliance on retained seeds or donated inputs and traditional technology, little valuation of inputs and outputs and wide product mix. The characteristics of commercial farmers are production for the market with a strong focus on generating profits, active participation in input and output

	markets, active investments in inputs and technology, reinvestment of profits into inputs and technology, valuation of Inputs and outputs and narrow product range.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Availability of innovations • Farmers' willingness to finance the innovations • Risk tolerance levels • Levels of production • Levels of profit
Partners/stakeholders for scaling up and their roles	• Farmers – Undertakes innovations • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Demanding goods • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Small-scale farming • Inadequate information to stakeholders on the Cabbage production and marketing • Subsistence farming • Levels of policy support
Suggestions for addressing the challenges	• Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production – Developing information hub • Subsistence farming – adoption of innovations • Level of policy support – support in extension services
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with subsistence-oriented production • Environmental conditions – supporting use of innovations • Policy conditions – Policy supporting innovations • Market conditions – Less Cabbage market competition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women lack entrepreneurial skills and capacity to engage in the marketing innovation model compared with men

	• Women lack basic reading and numeracy skills so they can run their businesses compared with men • Women may not apply for loans that can be used to start their businesses and increase their profits due to lack of collateral compared with men
Gender related opportunities	• Opportunities exist for women to venture in entrepreneurship through the women enterprise fund
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs lack basic reading and numeracy skills so they can run their businesses compared with men • VMGs may lack the business acumen to venture in the marketing innovation model compared with men • VMGs may lack the starting capital
VMG related opportunities	• Innovations applicable to VMGs
	• Innovations accessible 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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Rates of innovation adoption
- Levels of subsistence
- Productivity of Cabbage
- Profitability

2.11.6 TIMP Name	**Contracted production model**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Despite contractual strategy being an option in cabbage value chain development, it is rarely used. Sometimes it is rarely honored by parties involved. This has led to low prices and incomes to farmers. This disorganizes cabbage marketing systems triggering low technology uptake among farmers

What is it? (TIMP description)	Contract farming involves contractors who private companies are 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 contracted out to producers at an agreed price. On the other hand, producers provide labour and manage the contracted farming activity
Justification	Without contract farming smallholder farmers face poor market access for the Cabbage production. 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.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Availability of willing farmers • Availability of traders • Competitiveness of Cabbage varieties
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff - Capacity building • 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	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on contract farming • 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 Cabbage

	production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production – Developing information hub • Inadequate information to stakeholders on contract farming – Capacity building • Level of policy support – support in extension services
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with subsistence-oriented production • Environmental conditions – Input support in the contract to improve natural resource management • Policy conditions – Policy support in opportunities selected
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women have less access to knowledge and information on contract farming than men. • Women have less access to land for cabbage farming than men.
Gender related opportunities	• Opportunities exist for youth to enter into contract farming through renting of land for cabbage farming for increased profit margins
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have less access to knowledge and information on contract farming than men. • VMGs have less access to land for farming than men.
VMG related opportunities	• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

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

2.11.7 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 performance of cabbage enterprises is attributed to poor marketing options that has led to the use of digital marketing strategy. This attributed to poor access to markets challenges in other marketing channels. Limited skills and asymmetry in market information
What is it? (TIMP description)	Internet and mobile marketing refer 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 and mobile marketing methods are 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 Cabbage production • Levels of experiences in Cabbage production • Availability of information on Cabbage production and marketing • Levels of competition among the Cabbage
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of Cabbage production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of Cabbage • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii

Challenges in development and dissemination -	• Digital skills of farmers • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Cabbage production and marketing • Internet connectivity • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production organizations • Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production – Developing information hub • Internet connectivity – Information hub • Level of policy support – support in extension services
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts between subsistence-oriented production and commercial-oriented production • Environmental conditions – None • Policy conditions – Policy supporting information hub
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Women have less access to the required tools such as phones and computer than men. • Women are more illiterate and therefore cannot use the ICTs compared with men.
Gender related opportunities	• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have phones or the computers.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have less access to the required tools such as phones and computer than men.
VMG related opportunities	• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have access to phones or computers.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

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

2.11.8 TIMP Name	**Building a Business Plan for Cabbage production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Most actors along the cabbage value chain do not have business plan while engaging in cabbage business ventures. This to poor implementation of activities in cabbage production and marketing This has led to poor production targets, losses and market orientation.
What is it? (TIMP description)	A business plan is a document which guides the business operations in a farm. The document contains details such as introduction, bbusiness organization, pproducts, mmarketing strategy, rrisks, and business operation plan, marketing costs, Income streams, profit and loss analysis and financial requirements. The business plan provides a roadmap for the small farm business, an overall vision and mission to drive the business.
Justification	Farming Cabbage without a business plan is likely to fail because it lacks analysis of the production information, market information, financial support and business services. Building Cabbage business plan will assist farmers to organize themselves both at the farm and market levels.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, financial support services
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Education levels of farmers • Small-scale farming of Cabbage • Traditional farming of Cabbage • Availability of information on Cabbage production and marketing • Availability of farm business plan
Partners/stakeholders for scaling up and their roles	• Farmers – Developing farm business plans • County extension staff - Capacity building • NGOs – Capacity building • Research institutions – Capacity building

C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Cabbage production and marketing • Levels of education of farmers
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production organizations • Small-scale farming – allocation of more land to Cabbage production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Cabbage production – Developing information hub • Levels of education of farmers - Trainings
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts between with subsistence-oriented production and commercial-oriented production • Environmental conditions – Business plans to include Natural Resource Management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• High illiteracy levels of women leading to lack of record keeping and poor record keeping.
Gender related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Some of the VMGs are illiterate hence cannot keep good records.
VMG related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Adoption rate on the use of farm business plan
- Performance of the farm business plans

2.12 Agricultural Policy Options

2.12.1 TIMP Name	**National Agricultural Policy Strategies Framework for supporting Cabbage production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor entrepreneurship in cabbage business is attributed to lack of National Agricultural Policy guidelines that support the smallholder farmers creates challenge in cabbage business. Smallholder farmers' platforms to voice their grievances in terms of access to inputs and outputs markets. In addition, inappropriate instruments and rules for achieving broad policy productivity objectives for the smallholder farmers but instead favour the large scale farmers in Kenya.
What is it? (TIMP description)	The National Agricultural Policy strategies framework provides the objectives, instruments and rules for implementing productivity programs for the Cabbage
Justification	Without the National Agricultural policy strategy framework, Cabbage production will remain not integrated with the National development objectives. There will be lack of instruments and the rules to achieve Cabbage productivity objectives.
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), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of agricultural policies and specific Cabbage-based policies • Availability of policy goals, objectives and key areas of concerns
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Cabbage policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers

	• Private sector (local traders and exporters) – Demanding Cabbage policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Poorly established Cabbage value chain • Cabbage production are specific to agro-ecological zones and not all the Counties in Kenya grow Cabbage
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Cabbage value chain – strengthening Cabbage value chain • Cabbage production are specific to agro-ecological zones and not all the Counties in Kenya grow Cabbage – Diversification of Cabbage
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Low productivity of Cabbage • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Cabbage policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination,	• Inadequate representation of VMGs in policy development

adoption and scaling up	forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

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

2.12.2 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	Poor performance of cabbage enterprise is attributed to Noncompliance to follow the policy implementation procedures has led to poor polies being developed. This has led to negative impacts of the polies to cabbage value chain development including input and output markets
What is it? (TIMP description)	The policy cycle is normally conceptualized as sequential parts or stages. These are (1) problem emergence, (2) agenda setting, (3) consideration of policy options, (3) decision-making, (5) implementation, and (6) evaluation. The cycle is a valuable device for involving the smallholder farmers of Cabbage to articulate their issues in the Cabbage production and marketing and therefore initiate the centralization of their agencies and voices.

Justification	Without the use of policy cycle, the Cabbage production and marketing will remain under-developed. There will be a disconnection between government policy setting and the likings of the smallholder farmers.
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), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of agricultural policies and specific Cabbage-based policies • Availability of policy goals, objectives and key areas of concerns
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Cabbage policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Cabbage policies to support production and marketing
	• Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Poorly established Cabbage value chain • Cabbage production are specific to agro-ecological zones and not all the Counties in Kenya grow Cabbage
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Cabbage value chain – strengthening Cabbage value chain • Cabbage production are specific to agro-ecological zones and not all the Counties in Kenya grow Cabbage – Diversification of Cabbage
Lessons learned in up scaling if any	• None

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Low productivity of Cabbage • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Cabbage policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

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

2.12.3 TIMP Name	**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	Low Cabbage productivity is attributed to lack of County Government support in the access of inputs and outputs markets among the smallholder farmers causing dis-organization the subsector.
What is it? (TIMP description)	The County Integrated Development Planning (CIDP) is a five year plan developed by County governments to guide County investments. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Cabbage production, marketing and processing are considered. .
Justification	Without sensitizing the smallholder farmers of Cabbage on the CIDP, the crop will remain under-developed. It is essential for the farmers to understand and implement the CIDP
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), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of County Integrated Development Plans • Levels of literacy among the smallholder farmers of Cabbage. • Willingness of farmers to participate in the development of CIDP
Partners/stakeholders for scaling up and their roles	• Farmers – Providing data for the agricultural policy concerns • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers
	• Private sector (local traders and exporters) – Contributing to the development of County Integrated Development Plans • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up scaled	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado, Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming

	• Inadequate information to stakeholders on the CIDPs County
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the CIDPs
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Low productivity of Cabbage • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Cabbage policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation
E: Case studies/profiles of success stories	
Success stories from previous similar projects	All Counties in Kenya
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to CIDPs
- Farmer accessibility to production inputs

2.12.4 TIMP Name	Policy Instruments Related to Cabbage
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Cabbage productivity is attributed to poor existing policy instruments which do not support the smallholder farmers' issues in accessing inputs and outputs markets. Therefore, weak policy instruments have led to the market failure for both inputs and outputs
What is it? (TIMP description)	The policy instruments are the means to achieve policy objectives. The policy instruments related to the Cabbage production and marketing include subsidy in the inputs and also minimum price for the Cabbage outputs.
Justification	Without the appropriate and application of the policy instruments by the smallholder farmers, the Cabbage productivity will remain low. The policy productivity objective could also be achieved through efficiency, distributive, or stability effect.
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), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of policy instruments • Levels of literacy among the smallholder farmers of Cabbage.
Partners/stakeholders for scaling up and their roles	• Farmers – Users of policy instruments • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Users of policy instruments • Research institutions – Sensitization of stakeholders
	•
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga-Mwea and Kagio areas
Counties where TIMPs will be up	Trans Nzoia, West Pokot, Uasin Gishu, Tharaka Nithi, Kajiado,

scaled	Kisii
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inappropriate policy instruments
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Update of the policy instruments
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Literacy levels among the smallholder farmers of Cabbage • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Cabbage policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For Cabbage Pruktor F1which is the best hybrid cabbage variety, the total basic cost is estimated at Ksh. 83,100 per acre
Estimated returns	If you get 15,000 heads x Ksh 20 per head = Ksh 300,000 (Gross Profit). Ksh 300,000- Ksh 83,100 = Ksh 216,900 (Net Profit) per acre
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
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	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Adoption of policy instruments
- Equity distribution among the stakeholders
- Farmer accessibility to production inputs
- Improvement in Cabbage output market

Kenya Climate Smart Agriculture Project (KCSAP)
P.O. Box 57811-00200, City Square, Nairobi, 'Kenya

www.kalro.org