



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



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DISCLAIMER

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

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FOREWORD

The Kenya Agricultural and Livestock Research Organization (KALRO) through the support of development partners has laid a strong foundation for growth and commercialization of agriculture in Kenya. This has been done through the development of Climate Smart Technologies, Innovations and Management Practices (TIMPs) through the adaptive and applied research guided by some of the research gaps identified earlier. In addition, the organization has embraced an interconnected information communication technology to ease the handling of data and information from research. A notable inclusion is the use of the Big Data Platform to integrate digital information from value chains. The National Agricultural Value Chain Development Project (NAVCDP) seeks to build on and deepen investments into interventions on productivity enhancement, community-led farmer extension, water management investments and data-driven value chain services from KCSAP and NARIGP previous projects. In this NAVCDP project, KALRO seeks to strengthen, customize and update the existing inventories of TIMPs, with emphasis on climate resilience, safer food production practices, value addition, nutrition, market participation and commercialization.

With the continued support, KALRO also is poised to continue providing quality technical assistance for value chain development at all levels and build capacity of county level implementation units to anchor project activities. With the support of NAVCDP, KALRO has developed inventories of TIMPs for the two new value chains, pyrethrum and rice and is continuously expanding, updating and revising existing inventories of TIMPs. In doing so, KALRO further strengthens climate resilience, value addition and market participation aspects of the updated TIMPs to support farmers to transition from subsistence to commercial farming. The organization continues to support the strengthening of the current Big Data platform at KALRO as the foundational database for insight-driven, more productive, resource efficient and climate-resilient farming. To enhance the effective coordination of research linkages and agriculture digitization, KALRO and the Ministry of Agriculture and Livestock Development have put in relevant support mechanisms to oversee the implementation of these activities.

Extensive information from research and background data has been used to develop this revised Inventory of TIMPs for the Cashew Value chain. 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 a 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 the achievement of the Project Development Objective (PDO), which is to increase market participation and value addition for targeted farmers in select value chains in project areas. This revised TIMPs inventory is to be used in conjunction with the respective ToT Manual.

Finally, I am greatly indebted to the value chain leaders and all those who participated in the preparation and revision of this Inventory of TIMPs for the Potato Value Chain. 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 National Agricultural Value Chain Development Project (NAVCDP) is a Government of Kenya project with support from the World Bank. The five-year project is being implemented in 34 counties clustered in seven regions at an approximate cost of US\$ 275 million. The project development objective (PDO) is “increase market participation and value addition for targeted farmers in select value chains in project areas.” It is expected that this objective will be achieved through implementing the five project components, namely; Building Producer capacity for climate resilient stronger value chains; Climate Smart Value Chain Ecosystem Investments; Piloting Climate Smart Safer Urban Food Systems; Project Coordination and Management; and Contingent Emergency Response Component.

The National Agricultural Value Chain Development Project aims to support 3.8 million small-scale farmers transitioning from subsistence to commercial farming, or are selling only a small percentage of their produce commercially. Additional beneficiaries of the Project include value chain actors at various levels, the extension workers, aggregators, logistics support providers and SMEs operating within the value chain. The Project places a strong focus on inclusion of women farmers within the supported Value Chains (VCs). Thirteen VC’s have been selected based on a thorough qualitative and quantitative assessment of their potential. The selected VCs based on their ranking are Dairy, Chicken, Coffee, Avocado, Banana, Mango, Irish potatoes, Tomato, Apiculture, Pyrethrum, Cashew nut, Cotton and Rice. Additional value chains prioritized by counties will be supported by their respective County Project Coordination Units.

The National Agricultural Value Chain Development Project has partnered with KALRO to continue strengthening and expanding the existing inventory of TIMPs with an emphasis on climate resilience, value addition, nutrition, and safer food production practices. Through this partnership, KALRO has developed Technologies, Innovations and Management Practices (TIMPs) inventories for the two new value chains - Rice and Pyrethrum, and revised existing inventories of TIMPs for all other value chains developed during the implementation of KCSAP and NARIGP. It also supports the strengthening of the existing Big Data platform at KALRO as the foundational database for insight-driven, more productive, resource-efficient and climate-resilient farming. Finally, the Ministry of Agriculture, Livestock Development (MoALD) has put in place relevant support mechanisms with KALRO to oversee effective implementation, coordination of research linkages and agriculture digitization.

In developing suitable inventories of TIMPs and corresponding ToT manuals, KALRO has leveraged information resources as well as those of its partners and collaborators. Use of these information resources, coupled with the accompanying training and contribution of the other project components, will go a long way in enabling NAVCDP to meet its development objectives.

The National Project Coordination Unit is grateful to all who participated in the development and production of this revised Inventory of TIMPs for Potato 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.

Samuel Guto, PhD

National Project Coordinator

National Agricultural Value Chain Development Project

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ABBREVIATIONS AND ACRONYMS

ASL	Above Sea Level
CSA	Climate Smart Agriculture
GHG	Greenhouse Gases
KALRO	Kenya Agricultural and Livestock Research Organization
NAVCDP	Kenya Climate Smart Agricultural Project
PDO	Project Development Objectives
TIMPS	Technologies, Innovations and Management Practices
NARS	National Agricultural Research Systems
CGIAR	Consultative Group for International Agricultural Research
ToT	Training of Trainers
IPR	Intellectual Property Rights
VC	Value Chain
PCN	Potato Cyst Nematodes
ISFM	Integrated Soil Testing Services
Hp	Horse Power
KTN	Kenya Television Network
MOALD	Ministry of Agriculture & Livestock Development
CIP	International Potato Centre
ICIPE	International Centre for Insect Physiology and Ecology
FAO	Food and Agriculture Organization
FSRP	Food System Resilient Project
NGO	Non- governmental Organization
NAVCDP	National Agricultural Value Chain Development Project
NPCK	National Potato Council of Kenya
KEPHIS	Kenya Plant Health Inspectorate Service
FFBS	Farmer Field and Business School
VMGs	Vulnerable and Marginalized Groups
SMEs	Small and Medium Enterprises
CIGs	Common Interest Groups
NPCK	National Potato Council of Kenya
PVX	Potato Virus X
PLRV	Potato Leaf Roll Virus
°C	Degree Celcius
DNA	Deoxyribonucleic Acid
RACs	Rooted Apical Cuttings
SDGs	Sustaibnable Development Goals
PPP	Public Private Partnerships
QDS	Quality Declared Seed
CTA	Technical Centre for Agricultural and Rural Cooperation
EIAR	Ethiopian Institute of Agricultural Research
ARARI	Amhara Regional Agricultural Research Institute
DLS	Diffused Light Store
TPS	True Potato Seed
HTPS	Hybrid True Potato Seed
HACCP	Hazard Analysis Critical Control Points
CCPs	Critical Control Points
IPM	Integrated Pest Management
ICM	Integrated Crop Management
CoG	Council of Governors

IMM	Integrated Manure Management
AEZ	Agro-ecological Zones
ASALs	Arid and Semi Arid Lands
ASK	Agricultural Society of Kenya
CA	Conservation Agriculture
FFS	Farmer Field Schools

1.0 Definition of terms and summary tables of Potato Technologies, Innovations and Management Practices (TIMPS)

1.1 Definition of terms

Agripreneur: An established commercial agri-entrepreneur who will be mentored and coached by a business accelerator to deliver E-extension sustainably and provide digital data on TIMPS dissemination and adoption.

Technology: This is defined as an output of a research process which is beneficial to the target clientele (mainly farmers, pastoralists, agro-pastoralists and fisher folk for NAVCDP'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.

Innovation: This is defined as 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).

Management practice: This is defined as recommendation(s) on practice(s) that is/are considered necessary for a technology to achieve its optimum output. These include, for instance, different agronomic and practices (seeding rates, fertilizer application rates, spatial arrangements, planting period, land preparation, watering regimes, etc.), protection methods, for crops; and feed rations, management systems, disease control methods for animal breeds. This is therefore important information which is generated through research to accompany the parent technology before it is finally released to users and the technology would be incomplete without this information.

1.2 Summary of Inventory of TIMPs in the Potato Value Chain

The inventory process resulted in a total of **109** TIMPs including 49 technologies, 9 innovations and 51 management practices, distributed among the 12 sub-themes, as indicated in Table 1.

Table 1. Summary of Innovations, Technologies and Management Practices

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Potato	Potato improvement approaches for food security, processing and economic growth	20	0	3
Potato	Seed Systems	10	0	0
Potato	Food Safety and GAPs	0	0	2
Potato	Agronomic Practices in Potato Production	0	0	3
Potato	Integrated Soil and Water Management Practices in Potato Production	2	1	9
Potato	Crop Health	0	0	18
Potato	Weed Management in Potato Production	5	0	1
Potato	Potato Post-harvest TIMPs	2	0	3
Potato	Value Addition of Potatoes	2	8	0
Potato	Potato Mechanization	8	0	0
Potato	Smallholder Potato Farming Business and Marketing	0	0	8
Potato	Agriculture Policy Options	0	0	4
Overall Total		49	9	51

1.3 Summary of Status of TIMPs in Potato Value Chain

The inventory process resulted in a total of 109 TIMPs; 36 that are ready for up-scaling, 12 TIMPs that require validation and 24. TIMPs that require further research in the sub-themes, as indicated in Table 2.

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

Commodity/VC	Sub-Theme	Ready for up-scaling	Require validation	Further Research
Potato	Potato improvement approaches for food security, processing and economic growth	14	0	9
Potato	Seed Systems	9	0	1
Potato	Food Safety and GAPs	2	0	0
Potato	Agronomic Practices in Potato Production	7	2	5
Potato	Integrated Soil and Water Management Practices in Potato Production	4	3	5
Potato	Crop Health			
Potato	Weed Management in Potato Production			
Potato	Potato Post-harvest TIMPs			
Potato	Value Addition of Potatoes			
Potato	Potato Mechanization			
Potato	Smallholder Potato Farming Business and Marketing			
Potato	Agriculture Policy Options			
Overall Total		36	13	24

TABLE 3: INVENTORY OF POTATO TIMPS BY CATEGORY AND STATUS

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.0 Potato improvement for food security, processing and	2.1 Potato variety Shangi	Technology	Ready for upscaling
	2.2 Potato variety Kenya Mpya	Technology	Ready for upscaling
	2.3 Potato variety Unica	Technology	Ready for upscaling
	2.4 Potato variety Kenya Karibu	Technology	Ready for upscaling
	2.5 Potato variety Dutch Robyjn	Technology	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
economic growth	2.6 Potato variety Sherekea	Technology	Ready for upscaling
	2.7 Potato variety Asante	Technology	Ready for upscaling
	2.8 Potato variety Tigoni	Technology	Ready for upscaling
	2.9 Potato variety Lenana	Technology	Ready for upscaling
	2.10 Potato variety Konjo	Technology	Ready for upscaling
	2.11 Potato variety Wanjiku	Technology	Ready for upscaling
	2.12 Potato variety Nyota	Technology	Ready for upscaling
	2.13 Potato variety Chulu	Technology	Ready for upscaling
	2.14 Potato Advance clone 6C11	Technology	Further research
	2.15 Potato Advance clone IHC	Technology	Further research
	2.16 Potato Advance clone 6B170	Technology	Further research
	2.17 Potato Advance clone 1G70	Technology	Further research
	2.18 Potato Advance clone 3C22	Technology	Further research
	2.19 Potato Advance clone IG35	Technology	Further research
	2.20 Potato Advance clone 1 HB	Technology	Further research
	2.21 Potato Variety descriptors	Management practice	Ready for upscaling
	2.22 Potato Suitability Maps	Management practice	Further research
	2.23 Genetic fingerprinting	Management practice	Further research
3.0 TIMPs on Seed Systems	3.1 Tissue culture	Technology	Ready for upscaling
	3.2 Aeroponics	Technology	Ready for upscaling
	3.3 Rooted Apical cuttings technology	Technology	Ready for upscaling
	3.4 Sand ponics	Technology	Ready for upscaling
	3.5 Positive seed selection	Technology	Ready for upscaling
	3.6 Satellite seed potato bulking	Technology	Ready for upscaling
	3.7 Quality declared seed	Technology	Ready for up-scaling
	3.8 Sprouting technologies	Technology	Ready for upscaling
	3.9 Cut seed potato tubers	Technology	Further research
	3.10 True potato seed (TPS)	Technology	Ready for upscaling
4.0 TIMPs on Food Safety and GAPS	4.1 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Potato Value Chain in Kenya	Management practice	Ready for up-scaling
	4.2 Good Agricultural Practices (GAP) and Standards in Potato Production	Management practice	Ready for Up-scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
5.0 TIMPs on Agronomic Practices in Potato Production	5.1 Spacing	Management practice	Ready for Up-scaling
	5.2 Hilling/Earthing Up	Management practice	Ready for Up-scaling
	5.3 Harvesting	Management practice	Ready for Up-scaling
6.0 TIMPs on Integrated Soil and Water Management Practices in Potato Production	6.1 Integrated Manure Management	Management practice	Requires Validation
	6.2 Integrated Soil Fertility Management (ISFM)	Management practice	Requires Validation
	6.3 Rapid Soil Testing Services	Innovation	Requires Validation
	6.4 Bench Terraces	Management Practice	Ready for Up-scaling
	6.5 Fanya Juu Terraces	Management Practice	Ready for Up-scaling
	6.6 Retention Ditches	Management Practice	Ready for Up-scaling
	6.7 Grass Strips	Management Practice	Ready for Up-scaling
	6.8 Intercropping	Management Practice	Requires Further Research
	6.9 Crop Rotation	Management Practice	Ready for Up-scaling
	6.10 Mulching	Management Practice	Ready for Up-scaling
	6.11 Use of Drip Irrigation in Potato Production	Technology	Ready for Up-scaling
	6.12 Zeba	Technology	Requires Further Research
7.0 Crop Health	7.1 Integrated Management of Potato Cyst Nematode	Management Practice	Ready for Upscaling
	7.2 Integrated Management of Potato Tuber Moth	Management Practice	Ready for Upscaling
	7.3 Integrated Management of Aphids	Management Practice	Ready for Upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	7.4 Integrated Management of Mealybugs of Potatoes	Management Practice	Ready for Upscaling
	7.5 Integrated Management of White Flies	Management Practice	Ready for Upscaling
	7.6 Integrated Management of Spider Mites	Management Practice	Ready for Upscaling
	7.7 Integrated Management of Leaf Miner	Management Practice	Ready for Upscaling
	7.8 Integrated Management of Cutworms	Management Practice	Ready for Upscaling
	7.9 Integrated Management of Millipedes	Management Practice	Further Research
	7.10 Integrated Management of Slugs	Management Practice	Ready for Upscaling
	7.11 Integrated Management of Bacterial Wilt	Management Practice	Ready for Upscaling
	7.12 Integrated Management of Late Blight Disease	Management Practice	Ready for Upscaling
	7.13 Integrated Management of Potato Blackleg Disease	Management Practice	Ready for Upscaling
	7.14 Integrated Management Soft Rot	Management Practice	Ready for Upscaling
	7.15 Integrated Management of Potato Leaf Roll Virus	Management Practice	Ready for Upscaling
	7.16 Integrated Management of Potato Virus Y	Management Practice	Ready for Upscaling
	7.17 Integrated Management of Potato Virus X	Management Practice	Ready for Upscaling
	7.18 LAMP Technology for Rapid Detection of Bacterial Wilt, Dikeya and Viruses in Potato	Management Practice	Requires Validation
8.0 Weed Management in Potato Production	8.1 Integrated Weed Management	Technology	Ready for Upscaling Requires Validation
	8.2 Mulching for Weed Management in Potato	Technology	Ready for Upscaling Requires Validation
	8.3 Chemical Weed Control in Potato	Technology	Ready for upscaling
	8.4 Solarization Bed for Weed Control in Potato	Technology	Requires validation Requires further research

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	8.5 Safe Use of Herbicides in Potato	Management Practice	Ready for upscaling
	8.6 Mechanical Weed Control in Potato	Technology	Ready for upscaling
9.0 Potato Post-harvest TIMPs	9.1 Dehaulming	Management Practice	Ready for upscaling
	9.2 Maturity Indices and Correct Time for Harvesting Potatoes	Management Practice	Requires Validation
	9.3 Curing for Storage of Ware Potatoes	Technology	Ready for upscaling
	9.4 Sorting and Grading	Management Practice	Ready for upscaling
	9.5 Ambient/Naturally Ventilated Ware Potato Store	Technology	Requires Validation
10.0 TIMPs on Value Addition of Potatoes	10.1 Potato Flour	Innovation	Ready for Upscaling
	10.2 Production of Potato Starch	Technology	Requires Validation
	10.3 Potato Crisps	Technology	
	10.4 Potato Chips/Fries	Innovation	Ready for Upscaling
	10.5 Potato/Wheat Chapati	Innovation	Ready for Upscaling
	10.6 Potato Mandazi	Innovation	Ready for Upscaling
	10.7 Potato Buns	Innovation	Ready for Upscaling
	10.8 Potato Fritters	Innovation	Ready for Upscaling
	10.9 Potato/Wheat Noodles	Innovation	Require Validation
	10.10 Potato/Wheat Doughnuts	Innovation	Ready for Upscaling
11.0 TIMPs on Potato Mechanization	11.1 Power Tiller	Technology	Ready for upscaling
	11.2 Wheeled Tractor 50Hp	Technology	Ready for upscaling
	11.3 Mould Board Plough	Technology	Ready for upscaling
	11.4 Harrow	Technology	Ready for upscaling
	11.5 Potato Planter	Technology	Ready for upscaling
	11.6 Motorized Sprayer	Technology	Ready for upscaling
	11.7 Harvester	Technology	Requires further research
	11.8 Grader	Technology	Requires further research
12. Smallholder Potato Farming Business and Marketing	12.1 Transformative Model of Potato Production	Management Practice	Requires Validation
	12.2 Profitability Analysis	Management Practice	Ready for Upscaling
	12.3 Market Research	Management Practice	Requires Validation
	12.4 Collective Marketing	Management Practice	Requires Validation

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	12.5 Marketing Innovation Model	Management Practice	Requires Validation
	12.6 Contracted Potato Production Model	Management Practice	Requires Validation
	12.7 Internet/Mobile Marketing	Management Practice	Requires Validation
	12.8 Building a Business Plan for Potato Production	Management Practice	Requires Validation
13. Agriculture Policy Options	13.1 The National Potato Policy Strategy	Management Practice	Ready for Upscaling
	13.2 Policy Cycle	Management Practice	Requires Validation
	13.3 County Integrated Development Planning	Management Practice	Ready for Upscaling
	13.4 Policy Instruments for the Producers of Potato	Management Practice	Ready for Upscaling

2.0 Crop Improvement TIMPS: Improved potato varieties for food security, processing and economic growth

2.1 Potato varieties

2.1.1 Potato Variety: Shangi

Technology name	Potato Variety: Shangi
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Potato varieties with a large market share tend to be susceptible to pests and diseases making them difficult to grow because they require regular spraying with fungicides
What is it? (TIMP description)	<p>Shangi is a 1m tall semi-erect potato plant with purple flowers, broad leaves, with oval shaped medium to large tubers, with cream white skin, deep pink eyes and cream yellow flesh with a characteristically short dormancy. Suitable altitude is 1400 to 3000 m a.s.l, sufficient and well distributed rainfall or supplement moisture by irrigation, optimal temperature of 15 to 20°C. Suitable soils of sandy loams preferably but also silty loams and clay loams. This variety is susceptible to late blight and all potato viruses.</p> <p><i>Shangi variety flower and tubers</i></p> <div> </div> <div> </div> <p><i>Source: Photos courtesy of Judith Oyoo, KALRO</i></p>
Justification	Shangi variety commands over 80% market share. It's early maturing and well adapted to various agro-ecological zones. It is a climate smart variety since it has a short life cycle, drought tolerant and versatile for processing as well as cooks fast and hence energy saving.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, processors, extension service providers, agripreneurs, seed producing companies and SMEs, consumers, researchers. Other research institutions such as universities
Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital

	platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer TV etc),workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	Preferred traits by processors, traders, marketers, farmers and consumers funding by government to promote production and distribution of seed of selected potato varieties Aggressive advertisements and marketing promotions through PPP
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture and Livestock Development- Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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) • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): Farmer Input Promotion • KEPHIS – Inspection services • CBOs, NGOs (technology upscaling, seed potato multiplication) • Processors –potato processing and value addition
C: Current situation and future scaling up	
Counties where already promoted, if any	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet and Nandi.
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by Counties
Challenges in dissemination	<ul style="list-style-type: none"> • Limited exposure by the end-user to the technology • Limited Community Interest Groups (CIG) based supportive seed system • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field days, road shows and FFBS for aggressive awareness creation about the variety • Capacity building of all value chain actors especially traders and processors • Strengthen community based certified seed potato production

Lessons learned in up-scaling, if any	Use of FFBS is effective in technology dissemination and adoption and involvement of farmers alone is not enough to support adoption, need to all stakeholders in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmer willingness, available and reliable markets • Favorable weather and good storability • Awareness and acceptability of the variety by target communities. • Enabling policy framework such as the Crops Act (Potato Production and Marketing Regulations) 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs approximately KES120,000 per acre
Estimated returns	Estimated output of 120 bags of 50 kg @KES 1500; total revenue KES 180,000 less costs of KES 120,000 = KES 60,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women and youth are mostly engaged in production while marketing is dominated by men, women and youth become excluded from income opportunities and miss out on taking up newer technologies
Gender related opportunities	<ul style="list-style-type: none"> • There is employment for women and youth in value addition and processing (fresh cuts, fresh packs, pre-cooked products, fresh crisps, starch extraction) which can accommodate all gender groups equally • Improved production of potatoes attracts men at various nodes of the value chain • Shangi is early maturing and well adapted to various agro-ecological zones makin all year round production and marketing possible • It is easy to cook hence energy saving
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs do not have adequate knowledge on the existing potatoes varieties • VMGs have limited access to inputs for production such as land, credit facilities and equipments • VMGs have limited accesses to agricultural and extension information VMGs are exploited by middlemen while marketing their products
VMG related opportunities	<ul style="list-style-type: none"> • There will be creation of employment for VMGs at various nodes • Improved production of potatoes increasing incomes for VMGs


	<ul style="list-style-type: none"> For it being early maturing and well adapted to various agro-ecological zones ensures that there are stable supplies to the market It is easy to cook hence saves fuel for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Improved income generation from adopting potato variety Shanghi in Nyandarua, Bungoma, Trans-nzoia, Elgeyo marakwet and other potato growing Counties where Shanghi is grown
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture and Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

Poor storability/very short dormancy; deep eyes and therefore high wastage during peeling; poor color of processed products hence not good for processing.

2.1.2 Potato Variety: Kenya Mpya

Technology name	Potato Variety: Kenya Mpya
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice	
Problem to be addressed	Potato varieties with a large market share tend to be susceptible to pests and diseases making them difficult to grow because they require regular spraying with fungicides.
What is it? (TIMP description)	<p>Kenya Mpya is a high yielding, tolerant to late blight and early maturing variety. It has strong plants which are semi-erect, 1m high plant with white flowers. The tubers are oval/round shaped, cream white skin, large tubers with shallow pink eyes and cream yellow flesh. It has medium tuber dormancy period, very tolerant to late blight and potato viruses and easily deteriorates when exposed to light during storage. It is suitable for fresh chips and table consumption.</p>  <p><i>Kenya Mpya variety tubers and flower</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>
Justification	Kenya Mpya is a late maturing and well adapted to various agro-ecological zones. It is suitable for processing into frozen fries and yields 40 to 45 tons/ha. It is tolerant to late blight and most potato viruses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers, processors, agripreneurs, extension service providers, Seed producing companies and SMEs, consumers, researchers. Other research institutions such as universities
Approaches used in dissemination	Farmer Participatory Evaluation exercises; On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer TV etc), workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	Preferred traits by processors, traders, marketers, farmers and consumers increased public and private investment in the seed and ware potato value chains to promote production and distribution of seed potatoes Aggressive advertisements and marketing promotions through PPP
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture and Livestock Development MOALD-Extension and Capacity Building

	<ul style="list-style-type: none"> • CIP (International Potato Centre) – Collaborative research on potato variety development • 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) • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): Farmer Input Promotion • KEPHIS – Certification services • CBOs, NGOs (technology upscaling, seed potato multiplication) • Processors –potato processing and value addition
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Nakuru, Elgeyo Marakwet, Bungoma, Kisii; Murang'a
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	Lack of information about the variety/Non-exposure of the end-user to this technology, lack of community Interest Groups (CIG) based supportive seed system and very low publicity about K. Mpya
Suggestions for addressing the challenges	Scaling up participation of farmers in on-farm activities/adaptive research/extension activities Market promotions for variety Kenya Mpya targeting potato trader
Lessons learned in up-scaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Environmentally friendly resilient and climate smart • Availability of a reliable domestic and regional market • Awareness and acceptability of the variety by target communities • Enabling policy framework • Availability of a strong seed system to produce certified seed potato
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs approximately KES 120,000 per acre.
Estimated returns	Estimated output of 150 bags of 50 kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000 = KES 105,000

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women might not be aware of Kenya Mpya potatoes variety • Women have been growing poor qualities of potatoes since they lack information on the existing new varieties • Land ownership is mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women and youth are exploited by middle men while marketing their products
Gender related opportunities	<ul style="list-style-type: none"> • There will be employments for women and youth in value addition and processing (fresh cuts, fresh packs, pre-cooked products, fresh crisps, starch extraction) which can accommodate all gender groups equally • Improved production of potatoes attracts men at various nodes of the value chain
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs do not have adequate knowledge on the existing potatoes varieties • VMGs have limited access to productive resources such as land, credit facilities and equipments • VMGs have limited accesses to agricultural and extension information • VMGs are exploited by middle men while marketing their products
VMG related opportunities	<ul style="list-style-type: none"> • There will be capacity building for the VMGs to enhance adequate knowledge on the existing potatoes varieties • There will be creation of employment for VMGs at various nodes • Improved production of potatoes increasing incomes for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The variety has been successfully grown by several farmers in various counties with good performance
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org

Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development, MOALD, International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

2.1.3 Potato variety: Unica

Technology name	Potato variety: Unica
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields due to climate change and lack of drought tolerant high yielding varieties and high postharvest losses due to limited table processing varieties
What is it? (TIMP description)	<p>Unica is a medium tall strong and semi-erect plant with dark green leaves. Unica has purple flowers and has oblong shaped tubers, white shallow eyes, deep red skin and cream white flesh. Unica is drought and heat tolerant, moderately tolerant to late blight, resistant to potato viruses and high yielding >45 tons/ha. Unica does well in altitudes below 1500 m asl to 3000 m asl, well-draining soils preferably silty loams, sandy or clay loams. This variety is drought and heat tolerant and suitable for chipping and table consumption</p> <div> </div> <p><i>Unica variety flower and tubers</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>
Justification	The variety is early maturing, drought and heat tolerant with long dormancy so yields are high and can be stored for very long, hence

	ensuring household food security even in advent of climate change. It is a market demanded variety for processing into chips; accepted mainly by eastern part of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, processors, agripreneurs, extension service providers, Seed producing companies and SMEs, consumers, researchers. Other research institutions such as universities
Approaches used in dissemination	Farmer Participatory Evaluation exercises; On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc),workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for seed potato production • Field demonstrations to promote and market the variety
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture and Livestock Development-Extension and Capacity Building • CIP – Collaborative research on potato variety development • ICIPE – Collaborative research on crop protection • FAO - Co-sharing of resources and networking and knowledge management • CIGs - Back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (CARE Kenya)- Farmer Input Promotion
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Nyandarua, Elgeyo Marakwet, Uasin Gishu, Bungoma, Isiolo, Nairobi
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of variety/Non- exposure of the end-user to a technology • Limited market availability and low adoption rate due to low awareness
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field days, road shows and FFBS for aggressive awareness creation about the variety • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting processors



Lessons learned in upscaling if any	Adoption of FFBS effective in technology dissemination and adoption Public-private-partnership (PPP) is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Farmers' willingness, availability and reliable markets • Favorable weather • Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs approximately KES 120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @KES 1500; total revenue KES 270,000 less costs of Ksh 120,000 = KES 150,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women might not be aware of the existing new varieties such as Unica • Women and youth have limited access to agricultural information and extension services especially relating to the new technologies and innovations • Land ownership mainly by men and therefore women are not involved in decision making on the varieties to grow
Gender related opportunities	<ul style="list-style-type: none"> • Offers employment for women and youth at various nodes of the value chain • Unica potato variety is very marketable increasing income for women and youth • Increased production improves food security and nutrition for women and Youth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs do not have adequate knowledge on the existing potatoes varieties • VMGs have limited access to productive resources such as land, credit facilities and equipments • VMGs have limited accesses to agricultural and extension information • VMGs are exploited by middle men while marketing their products • Crop production is labour intensive for VMGs and they lack finances to hire labor • There is low adoption by the VMGs
VMG related opportunities	<ul style="list-style-type: none"> • There will be creation of employment for VMGs at various nodes • Improved production of potatoes increasing incomes for VMGs • For it being early maturing and well adapted to various agro-ecological zones ensures that there are stable supplies to the market • It is easy to cook hence saves fuel for VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Since Unica was released in 2016, it has been promoted mainly in Eastern regions of Kenya. Over 100 Potato farmers have been capacitybuilt on improved potato production technologies and marketing.
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa, Susan Otieno, Muthoni Jane., Onditi John., Nancy Ng'ang'a, Judith Oyoo, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi
Partner organizations	Ministry of Agriculture and Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

Research Gaps-Unica Variety

The variety has long dormancy hence the need to develop accompanying technology on dormancy breaking; rapid tuber expansion results in large distribution of ware sized tubers even in seed crops, accompanying technology on spacing needed to improve seed supply

2.1.4 Potato variety: Kenya Karibu

Technology name	Potato variety: Kenya Karibu
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Poor yields due to lack of disease tolerant varieties and high postharvest losses due lack of red skinned varieties demanded by the market
What is it? (TIMP description)	<p>Kenya Karibu is a tall erect with strong stems and dark green narrow pointed leaves. The variety yields 35 to 40 tons/ha, deep red smooth skin with deep red eyes, and round shaped. Kenya Karibu has medium dormancy period up to 3 to 4 months. It is good for table consumption. The variety is not drought tolerant and is tolerant to late blight. It produces very long stolons hence requiring careful use of machinery not to damage newly forming tubers and also needs more earthing up.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p><i>Kenya Karibu variety tubers and flower</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>
Justification	Kenya Karibu is a farmer accepted, market demanded and well adapted variety. It is a potential variety for processing into crisps and can be stored for long by household hence assuring households food security. Suitable altitude of 1800 to 3000 m asl. This variety requires well distributed rainfall or irrigation in case of rainfall failure, optimum temperature of 15-18°C during the day and 10°C night temperature, well-draining silty loams, sandy or clay loams
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches used in dissemination	Farmer Participatory Evaluation exercises and On-farm demos Field days, social and electronic media platforms

Critical/essential factors for successful promotion	Suitability for processing into crisps Capacity building in proper storage and processing
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture Livestock & Livestock Development (MOALD) – Extension and Capacity Building • CIP – Collaborative research on potato variety development • ICIPE -Collaborative research on crop protection • FAO - Co-sharing of resources and networking and knowledge management • CIGs - back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (CARE Kenya)-Farmer Input Promotion • KEPHIS – inspection services • CBOs, NGOs (technology up-scaling, seed potato multiplication) • Processors –potato processing and value addition
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Nakuru, Bomet, Kiambu and Nyandarua
Counties where TIMPs will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of variety/Non- exposure of the end-user to a technology • Low market access due because of limited market access; mainly Eastern Kenya
Suggestions for Addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – GAPs • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting grain traders
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Partnership is important in technology dissemination; involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • This variety is preferred for household food security but not for commercial purposes because of the long dormancy • It's mainly preferred in the Eastern part of Kenya where it is exported to Somali due to its ability to withstand long distance transportation and bruising
Social, environmental, policy and market conditions necessary for development and	<ul style="list-style-type: none"> • There is availability of market: domestic and regional • Farmer willingness, available and reliable markets • Favorable weather and good storability • Awareness and acceptability of the variety by target communities. • Enabling policy framework such as the Irish Potato Regulations, 2019

upscaling	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50kg KES. 3,500 @ 18 bags per acre (KES63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 170 bags of 50 kg @KES 1500; total revenue KES 255,000 less costs of KES 120,000 = KES 135,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may prefer to produce this variety but due to lack of access to land as an input, they may not adopt it • Women might not be aware of Kenya Karibu potato variety • Women have been growing poor qualities of potatoes since they lack information on the existing new varieties • Land ownership is mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men.
Gender related opportunities	<ul style="list-style-type: none"> • Kenya Karibu has potential for processing into crisps and therefore creates opportunity for women in production, retailing, value addition and marketing. • Youth will be engaged in production & processing through mechanization and business incubation models and marketing • The variety cooks fast hence less fuel consumption. • It has a long shelf life providing stable food and nutrition supply to women and the youth
VMG issues and concerns in development, dissemination, adoption and scaling up.	<ul style="list-style-type: none"> • VMGs may prefer to produce this variety but due to lack of access to land as an input, they may not adopt it • VMGs might not be aware of Kenya Karibu potato variety • VMGs might not have knowledge of existing new varieties hence they continue growing low yielding varieties which are usually recycled • VMGs are exploited by middle men while marketing their products • VMGs have no access to productive resources such as land, equipments and credit facilities • VMGs have limited access to agricultural information especially relating to new varieties
VMG related opportunities	<ul style="list-style-type: none"> • There will be creation of employment for VMGs at various nodes • Improved production of potatoes increasing incomes for VMGs • For it being early maturing and well adapted to various agro-ecological zones ensures that there are stable supplies to the market • It is easy to cook hence saves fuel for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Kenya Karibu has been promoted in most of the potato growing regions in Kenya. Adoption rates have been recorded high in Nyandarua, Kiambu, Meru, Nakuru, Uasin Gishu and Bungoma counties

Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture Livestock & Livestock Development MOALD, International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

Research Gaps for Kenya Karibu variety:

Wastage due deep eyes; trait improvement needed to develop shallow eyed variety accompanying innovation on spacing needed to optimize yield

2.1.5 Potato variety: Dutch Robyjn

Technology name	Potato variety: Dutch Robyjn
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of crisps processing variety
What is it? (TIMP description)	Dutch Robijn is an erect medium tall variety (about 0.7 meter in height) with strong stems and dark green medium sized leaves. It flowers scarcely and the flowers are white with a light pink hue. The tubers of this variety are pale red with characteristic rough skin, round in shape

	<p>(commonly referred to as 'golofu' as the round shape resembles the golf ball). It requires optimal rainfall or supplemental irrigation in case of drought, silty loams, sand clay loam or clay loams. This variety is not drought tolerant and yields are up to 30tons/ha. This variety is susceptible to late blight and potato viruses</p> <div> </div> <p><i>Dutch Robijn variety flower and tubers</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>
Justification	This variety is the best for fresh crisps making and roasting or baking. It is adaptable to the high altitudes
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, Seed producing companies and SMEs, Other research organizations/institutions (universities) & processors
Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc), workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	Contract based production enhanced Expanded processing markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP – Collaborative research on potato variety development • ICIPE – collaborative research on crop protection • FAO - co-sharing of resources and networking and knowledge management • CIGs - Back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (CARE Kenya)-Farmer Input Promotion
C: Current situation and future scaling up	

Counties where already promoted, if any	Nyandarua, Kiambu, Taita Taveta, Nakuru, Bomet, Elgeyo Marakwet, Uasin Gishu, Bungoma, West pokot, Nandi Emerging potato producing counties in mid-altitude AEZ (Trans-Nzoia, Embu, and Nairobi)
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Potato tubers from other regions except Bomet County are not easily marketed • Processors citing poor quality • Low adoption in other potato producing counties
Suggestions for addressing the challenges	Promotion of cottage industries in fresh crisps making by local communities, schools, hospitals or households
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Partnership is important in technology dissemination involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Environmentally friendly resilient • Farmer willingness, availability, trust in contractual agreement and reliable markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 120 bags of 50 kg @KES 1500; total revenue KES 180,000 less costs of KES 120,000=KES 60,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women might not be able to differentiate Dutch Robijn potatoes variety from the others • Women have been growing poor qualities of potatoes since they lack information on the existing new varieties • Women and youth select potato seeds from the previous harvest which leads to low yield • Land ownership is mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men
Gender related opportunities	<ul style="list-style-type: none"> • Since it is a highly demanded variety, it creates employment for women in production, retailing, value addition and marketing

	<ul style="list-style-type: none"> • There is potential of improved production leading to improved food security and nutrition for households • There is also potential of increased income from the sale of value added products from the potato variety
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are usually left out when key decisions relating to agricultural trainings, disseminations and project initiations • VMGs do not have adequate knowledge on the existing potatoes varieties • VMGs have limited access to productive resources such as land, credit facilities and equipments • VMGs have limited accesses to agricultural and extension information • VMGs have financial constraints since they do not have access to credit facilities hence they are not able to purchase new potato varieties
VMG related opportunities	<ul style="list-style-type: none"> • There will be creation of employment for VMGs at various nodes • Improved production of potatoes increasing incomes for VMGs • For it being early maturing and well adapted to various agro-ecological zones ensures that there are stable supplies to the market • It is easy to cook hence saves fuel for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Dutch robijn is the only variety used in commercial processing of potatoes into ready to eat snacks like crisps, chevda and potato sticks. The crisps are sold in urban centres in Kenya and beyond; exported to Tanzania, Uganda and Zimbabwe
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1- Ready for up-scaling
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi

Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs
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2.1.6 Potato variety: Kenya Sherekea

Technology name	Potato variety: Kenya Sherekea
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields and high postharvest losses due to lack of high yielding varieties with long storability period
What is it? (TIMP description)	<p>Sherekea is a semi-erect tall variety (slightly below 1m) with strong stems and pale green, medium sized leaves. It flowers profusely and the flowers are light purple. Sherekea does well in altitudes from 1500 to 2800 m a.s.l.; does well in fertile, well- draining soils with pH of 5.8 to 6.5; sufficient soil moisture; suitable temperature range of 15 to 24° C. Its tubers are round in shape, smooth red skin with deep red eyes. This variety is tolerant to late blight and PVX</p> <div> </div> <p><i>Sherekea variety flower and tubers</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>
Justification	Sherekea is a farmer accepted variety especially in north rift parts of Kenya which can be stored for long hence, preferred by boarding schools to make up diversity in their diets. The Variety has very high yields of over 45 tons/ha and holds potential for processing into the crisping industry
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agripreneurs

	Seed producing companies and SMEs Other research organizations/institutions (universities) Schools
Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc),workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on improved potato varieties alongside existing local varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development -Extension and Capacity Building • CIP – Collaborative research on potato variety development • ICIPE – collaborative research on crop protection • FAO - co-sharing of resources and networking and knowledge management • CIGs - Back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (CARE Kenya)-Farmer Input Promotion
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kiambu, Elgeyo marakwet, Bungoma
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of variety/Non- exposure of the end-user to a technology • Limited market availability and low adoption rate due to low awareness
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting grain traders
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Public-private-partnership (PPP) is important in technology dissemination
Social, environmental, policy and market	<ul style="list-style-type: none"> • Farmers' willingness, availability and reliable markets • Favorable weather

conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,200 @ 16 bags per acre (KES 63,000) including other costs total KES 120,000 per acre
Estimated returns	Estimated output of 180 bags of 50 kg @KES 1500; total revenue KES 270,000 less costs of KES 120,000 = KES 150,000
Gender issues and concerns in development, dissemination adoption and scaling up	Land ownership is mainly by men and therefore women are usually excluded in decision making or have no access to the land resource to produce the potatoes
Gender related opportunities	<ul style="list-style-type: none"> It offers employment for women and youth especially in processing and marketing crisps and fresh potatoes Kenya Sherekea variety can be stored for long offering stable food sources and nutritional security for women and youth Increased production and sales results in increased incomes for both women and youth Potential to create employment for the women and youth, service providers and marketing of the produce
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed. Limited participation in decision making at community and County level Some of the agronomic practices are not easy to undertake VMGs may have limited access to finances to buy the required inputs such as quality seedlings Due to their social status VMGs are often excluded from decision making in development and dissemination activities VMGs have limited access to education, training and extension services Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	<ul style="list-style-type: none"> Increased production and sales results in increased incomes for VMGs Potential to create employment for the VMGs It proved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The variety is very popular in Nandi, Uasin Gishu. Trans-nzoia and Elgeyo Marakwet Counties where small scale farmers produce and sell to secondary schools, in the area due to its good storability qualities It is a farmer accepted variety especially in north rift parts of Kenya

Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
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	The Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Co-operatives (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

Research Gaps- Sherekea Variety:

1. Long dormancy requires accompanying technology on sprouting technology for seed management and also breeding for shallow eye depth

2.1.7 Potato variety: Asante

Technology name	Potato variety: Asante
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited availability of high yielding varieties suitable for home consumption, tolerant to long distance transportation and long storage periods
What is it? (TIMP description)	<p>Asante is an erect tall variety (slightly below 1 meter) with strong stems and light green broad leaves. It flowers moderately and the flowers are pink; a high yielding variety (40-45 tons/ha); tolerant to late blight; medium dormancy (2 to 3 months). It does well in altitudes from 1500 to 2800 m a.s.l., with a temperature range of between 14 to 24°C. Good soils are the sandy loams and alluvials with good draining capacity and high fertility, with a pH of 5.8 to 6.5. The variety requires sufficient soil moisture throughout its growing period to give a good yield. Asante is not drought tolerant. Its characteristic features include; pale red skin with deep red eyes. It is good for table consumption.</p> <div> </div> <p><i>Asante variety tubers and flower</i> <i>Source: Photo courtesy of Judith Oyoo KALRO and Potato variety Catalogue 2022</i></p>
Justification	Asante is erect tall variety (slightly below 1 m) with strong stems and light green broad leaves. It flowers moderately and the flowers are pinkish purple. It is popular variety especially in north rift and eastern parts of Kenya. The variety has very high yields of over 45 tons/ha and holds potential for processing into crisps. This variety can store for long thus possessing good storability qualities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers</p> <p>Agripreneurs</p> <p>Seed producing companies and SMEs</p> <p>Other research organizations/institutions (universities)</p>

Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc),workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on Asante
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development -Extension and Capacity Building • CIP – Collaborative research on potato variety development • ICIPE – collaborative research on crop protection • FAO - co-sharing of resources and networking and knowledge management • CIGs - Back stopping the technologies at grass root levels
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Isiolo, Elgeyo Marakwet
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	Lack of information about the existence of variety/Non-exposure of the end-user to a technology
Suggestions for addressing the challenges	Scaling up participation of end-user in on-farm activities/adaptive research/extension activities
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Farmers' willingness, availability and reliable markets • Favorable weather • Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags

	per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 150 bags of 50 kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000 = KES 105,000
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women are not involved in decision making on the varieties to grow • Women farmers might not be aware of Asante potato variety and where it is grown due to limited access to agricultural information and extension services • Land ownership is mainly by men and therefore women are usually excluded in decision making or have no access to the land resource to produce the potatoes
Gender related opportunities	<ul style="list-style-type: none"> • There is a potential of women and youth having business in in processing and marketing products from the potatoes such as crisps • Asante potato variety can be stored for long offering stable food sources and nutritional security for women and youth • Increased production and sales results in increased incomes for both women and youth. • Has potential to create employment for the women and youth, service providers and marketing of the produce
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed. • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required quality potatoes seeds such as Asante • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of employment for VMGs at every node of the value chain; in clean potato production, potato processing whole packs, fresh cuts, crisps) and packaging • The variety is high yielding hence there is potential of improved incomes for VMGs • There is also potential for improved food security and nutrition for VMGs especially the sick
E: Case studies/profiles of success stories	
Success stories	Asante was released in 1998 and since then it has been widely grown 90% in Eastern regions of Kenya in Meru, Timau areas for selling in Isiolo, Marsabit up to Somalia.



Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	The Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

Research Gaps-Asante variety

Long dormancy requires accompanying technology on seed sprouting in seed potato management. Additionally, there is need to have mobile and web-based information portal/platform

2.1.8 Potato Variety: Tigoni

Technology name	Potato Variety: Tigoni
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Non availability of suitable variety for processing into frozen and fresh chips due to low farm yields (below 7 tons/ha)
What is it? (TIMP description)	It is a high yielding variety (35 to 40 tons/ha) and tolerant to late blight. It has a medium dormancy period. The variety is suitable for fresh chips, crisps and table consumption. Tigoni does well in high altitudes of above 2100 m to 3000 m a.s.l, with optimal temperatures of 12 to 18°C. Tigoni requires sufficient rainfall or water supply through irrigation incase of

	<p>drought. It has very poor in storage because of greening. Its characteristic features include; white skin with shallow white eyes, oval shaped and medium eye depth.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p><i>Tigoni variety tubers and flower</i> <i>Source: Photos courtesy of Judith Oyoo KALRO and Potato Variety Catalogue 2022</i></p>
Justification	<p>Tigoni is a erect tall variety (about 1 m) with strong stems and deep green broad leaves. It flowers profusely and the flowers are white. Tigoni is a cool adapted variety which ia not drought resistant. It is suitable for processing into frozen fries fresh chips; yields 35 to 40 tons/ha, tolerant to late blight and resistant to PVX.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)</p>
Approaches used in dissemination	<p>Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, Partners (CIP, NPCK, FAO, ICIPE, GIZ), Mobile phone text initiative, Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer, Workshops, Seminars, Meetings, trainings, Promotional materials (posters/brochures/leaflets), Social media platforms</p>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development -Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection

	<ul style="list-style-type: none"> • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted, if any	Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Bungoma, West pokot, Nandi, Embu
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	Lack of information about the existence of variety/non- exposure of the end-user to a technology
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field days, road shows and FFBS for aggressive awareness creation about the variety • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting processors
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness, availability and reliable markets • Favorable weather • Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 150 bags of 50kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000=KES 105,000
Gender issues and concerns in	<ul style="list-style-type: none"> • Land ownership is mainly by men and therefore women are usually excluded in decision making or have no access to the land resource to produce the potatoes

development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may not have time and mobility to attend trainings and other extension activities far from home or held at times as they have multiple roles to perform
Gender related opportunities	<ul style="list-style-type: none"> • It offers employment for women and youth especially in processing and marketing crisps and fresh potatoes • Kenya Tigonini variety can be stored for long offering stable food sources and nutritional security for women and youth • Increased production and sales results in increased incomes for both women and youth. • Potential to create employment for the women and youth, service providers and marketing of the produce
VMG issues and concerns in Development and dissemination	<ul style="list-style-type: none"> • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seedlings • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production and sales results in increased incomes for VMGs • Potential to create employment for the VMGs at various nodes of potatoes value chain • It provides food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Tigonini is well known countrywide. Farmers who grow it have obtained very high yields
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: 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-Tigonini P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigonini@kalro.org


Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Jane Muthoni., John Onditi., Miriam Mbiyu, Judith Oyoo., Patrick Pwaipwai and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO (Food and Agriculture Organization), Common Interest Groups (CIGs), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), NGOs (CARE Kenya)

Gaps Tigoni variety:

Variety is prone to greening both in the field and storage hence requires trait improvement to reduce greening; accompanying innovation on glycoalkaloid accumulation and quantification awareness creation on prevention of greening

2.1.9 Potato Variety: Lenana

Technology Name	Potato Variety: Lenana
Category(i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm yields (below 7 tons/ha) due to changing climate and limited varieties available that are drought tolerant
What is it? (TIMP description)	Lenana– a medium tall potato plant with strong semi erect stems and dark green medium size with white flowers. Shallow eyes, drought/heat tolerant, late maturing, high yielding, resistant to late blight, short dormancy period; suitable for fresh chips, french fries and table consumption. This variety does well in altitudes above 1500 to 3000 m asl. It has oval shaped tubers, white skin, cream white floes and shallow eye. It is also drought tolerant

	 <p><i>Lenana variety flower and tubers</i> Source: Photos courtesy of Judith Oyoo KALRO and Potato Variety Catalogue 2022</p>
Justification	Lenana – new introduction; well adapted; drought tolerant; shallow eyes; resistant to late blight, potato virus X (PVX) and potato leaf roll (PLRV)
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on improved potato varieties alongside existing local varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • MOALD- Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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

	<ul style="list-style-type: none"> • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Nandi, Kiambu
Counties Where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate supply of certified seed • Sprouts quickly hence poses storage challenges to retailers and processors
Suggestions for Addressing the challenges	<ul style="list-style-type: none"> • Supporting SMEs to do seed potato business • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities.
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS model is effective in dissemination and adoption of technologies • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness, availability and reliable markets • Favorable weather • Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 120 bags of 50 kg @KES 1500; total revenue KES 180,000 less costs of KES 100,000=KES 60,000
Gender-related opportunities	<ul style="list-style-type: none"> • Lenana has the potential for processing into crisps locally, creating employment for women in processing and marketing, youth in packing and distribution and ready snacks • Lenana potato variety is late maturing this quality ensures stable supply of potatoes to the market and also stable livelihoods for women and youth • Lenana variety is not expensive to produce since it is resistant to late blight hence saving money for women and youth which would have been used for buying pesticides

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seedlings • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production and sales results in increased incomes for VMGs • Potential to create employment for the VMGs • It provide food security and nutrition for VMGs • Lenana potato variety is late maturing this quality ensures stable supply of potatoes to the market and also stable livelihoods for the VMGs • Lenana variety is not expensive to produce since it is resistant to late blight hence saving money for VMGs which would have been used for buying pesticides
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Promoted in Nyandarua and Bungoma Counties
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni

	Moses Nyongesa., Susan Otieno., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ

Research Gaps- Lenana variety

Certified Seed potato availability

Awareness creation through promotion channels such as FFBS, field days

2.1.10 Potato variety: Konjo

Technology Name	Potato variety: Konjo
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields due to climate change
What is it? (TIMP description)	<p>Konjo– a medium tall potato plant with strong, semi erect stems and dark green medium size, leaves. It has pink flowers; grows well 1500 to 3000 m asl, silty loams, alluvials, clay and sandy loams, ph of 5.5. to 6.8 and temperature between 15 to 18°C. The tubers have cream white skin with red eyes, oval shaped; tubers high yielding, resistant to late blight, PVX and PLRV, suitable for fresh chips, french fries and table consumption</p> <div> </div> <div> </div> <p><i>Konjo variety tubers and flower</i> <i>Source: Potato Variety Catalogue 2022</i></p>
Justification	Konjo – well adapted; very early maturing variety; hence climate smart and good for processing

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Agripreneurs, Seed producing companies and SMEs</p> <p>Research organizations/institutions (universities)</p> <p>MOALD/Extension officers</p> <p>Partners (CIP, NPCK, FAO, ICIPE, GIZ)</p>
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises, On-farm demonstration • Field days, Agricultural shows, Mobile phone text initiative • Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer , Workshops, Seminars, Meetings, trainings, Promotional materials (posters/brochures/leaflets), Social media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on improved potato varieties alongside existing local varieties funding by government to promote production and distribution of certified seed potato
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development- Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua and Bungoma
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate supply of certified seed • Poor storability/short dormancy poses storage challenges to retailers and processors
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Supporting SMEs to do seed potato business • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting grain traders
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS model is effective in dissemination and adoption of technologies • Involvement of farmers alone is not enough to support adoption • Partnership is important in technology dissemination

	<ul style="list-style-type: none"> • Need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Important in the local diet • Environmentally friendly resilient and climate smart • There is availability of market: domestic and regional • One of the key crops identified under the food security pillar in the Big Four Agenda
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES 120,000 per acre
Estimated returns	Estimated output of 150 bags of 50 kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000 = KES 105,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Konjo has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as Konjo potato variety • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Konjo is high yielding hence there is a potential of increasing food security and nutrition for VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Promotion still ongoing
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
G: Contacts	KALRO-Tigoni,
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and Scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

Gaps Konjo variety

Seed availability

Awareness creation through promotion

2.1.11 Potato Variety: Wanjiku

Technology Name	Potato Variety: Wanjiku
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low adoption of potato varieties and low farm yields (below 7 tons/ha)
What is it? (TIMP description)	Wanjiku– medium tall potato plant with strong semi erect stems and dark green medium Size leaves with pinkish

	<p>flowers, drought/heat tolerant, early maturing; very high yielding, resistant to late blight, PVX, & PVY suitable for fresh chips and table consumption. It has short dormancy, oval shaped tubers which have pale white skin with medium deep pink eyes and dormancy reiod of 1 to 2 months. This variety does well in 1500 to 3000 m asl altitude, sufficient moisture, well-draining soils and temp of 15 to 18°C</p> <div> </div> <p><i>Wanjiku variety tubers and flower</i> <i>Source: Potato Variety Catalogue 2022</i></p>
Justification	<p>Wanjiku – drought tolerant, high yields, resistant to late blight and PVX and PLRV. Climate change is affecting crop production cycles, subsequent food security. Wanjiku variety will enable households to be food secure even with very little rainfall.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises, • On-farm demonstration, Field days, • Agricultural shows, Mobile phone text initiative, Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer, Workshops, Seminars, Meetings, trainings, Promotional materials (posters/brochures/leaflets), Social media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on improved potato varieties alongside existing local varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping Ministry of Agriculture Livestock & Livestock Development

	<ul style="list-style-type: none"> • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted, if any	Nyandarua, Bungoma
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate supply of certified seed • Lack of information about the existence of variety/Non-exposure of the end-user to a technology, • Limited market availability and low adoption rate due to low awareness
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Supporting SMEs to do seed potato business • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for new varieties targeting grain traders
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS model is effective in dissemination and adoption of technologies • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up- scaling	<ul style="list-style-type: none"> • Community and farmer willingness to adopt • Environmentally friendly resilient and climate smart. • There is availability of market: domestic and regional
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50kg KES. 3,200 @ 18 bags per acre (KES 63,000) including other costs total per acre Ksh 120,000
Estimated returns	Estimated output of 120 bags of 50 kg @KES 1500; total revenue KES 180,000 less costs of KES 120,000 = KES 60,000

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Wanjiku potatoe variety has the potential for processing into crisps locally, • It has created employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed. • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as Konjo potato variety • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Wanjiku potatoe variety is high yielding hence there is a potential of increasing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a, N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series

F: Status of TIMP readiness (1-ready for up- scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
G: Contacts	KALRO-Tigoni,
Contacts	The Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs


Research Gaps-Wanjiku variety

Seed availability

Awareness creation through promotion

2.1.12 Potato Variety Nyota

Technology Name	Potato Variety Nyota
Category (i.e. technology, innovation Or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low adoption of potato varieties and low farm yields (below 7 tons/ha)
What is it? (TIMP description)	Nyota– cream white skin with pale pink eyes, oval shaped; drought/heat tolerant early maturing; high yielding, susceptible to late blight., short dormancy period; suitable for fresh chips, crisps and table consumption, medium eye depth, poor storage

	 <p><i>Nyota variety tubers and flower</i> <i>Source: Potato Variety Catalogue 2022</i></p>
Justification	Nyota – farmer accepted variety countrywide; market demanded variety; well adapted; very early maturing variety; has very short dormancy period hence cannot store for long
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agpreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on improved potato varieties alongside existing local varieties • funding by government to promote production and distribution of seed of selected potato varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - Extension and Capacity Building, • CIP (International Potato Centre) – Collaborative research on potato variety development • 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

	<ul style="list-style-type: none"> • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted, if any	Nyandarua and Bungoma
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate supply of certified seed • Short dormancy
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Supporting SMEs to do seed potato business • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS model is effective in dissemination and adoption of technologies • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Community and farmer willingness • Market access and reliability • Enabling policy framework such as the Irish potato regulations 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @KES 1500; total revenue KES 240,000 less costs of KES 120,000=KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing

	<ul style="list-style-type: none"> • Nyota potato variety has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as Konjo potato variety • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMGs Opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Nyota is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Nyota is mid maturing which means it has the potential providing stable supply of potato products to the markets and livelihoods to VMGs
Success stories from previous similar projects	-
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	KALRO-Tigoni,
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., John Onditi., Susan Otieno., Nancy Ng'ang'a, Judith Oyoo, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi



Partner organizations	Ministry of Agriculture & Livestock Development, International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs
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Research Gaps- Nyota variety

Seed availability

Awareness creation through promotion

2.1.13 Potato variety Chulu

Technology Name	Potato variety Chulu
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low adoption of potato varieties and low farm yields (below 7 tons/ha)
What is it? (TIMP description)	<p>Chulu–drought/heat tolerant early maturing; high yielding, resistant to late blight, suitable for table consumption, well adapted; very early maturing variety; resistant to late blight</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p><i>Chulu variety tubers and flower</i> <i>Source: Potato Variety Catalogue 2022</i></p>
Justification	Chulu – climate smart variety that is tolerant to late blight and adaptable to low altitudes
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agpreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) • MOALD/Extension officers

	<ul style="list-style-type: none"> Partners (CIP, NPCK, FAO, ICIPE, GIZ)
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc), workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Recruitment and support for SMEs for potato production Field demonstrations on improved potato varieties alongside existing local varieties funding by government to promote production and distribution of seed of selected potato varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Ministry of Agriculture & Livestock Development -Extension and Capacity Building CIP (International Potato Centre) – Collaborative research on potato variety development 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 GIZ- Nutrition and potato utilization by the communities NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Bungoma
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> Inadequate supply of certified seed Sprouts quickly hence poses storage challenges to retailers and processors
Recommendations for addressing the challenges	<ul style="list-style-type: none"> Supporting SMEs to do seed potato business Scaling up participation of end-user in on-farm activities/adaptive research/extension activities
Lessons learned in upscaling if any	<ul style="list-style-type: none"> Adoption of FFBS model is effective in dissemination and adoption of technologies Partnership is important in technology dissemination Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market	<ul style="list-style-type: none"> Environmentally friendly resilient and climate smart. Availability of a reliable domestic and regional market

conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Awareness and acceptability of the variety by target communities. • Enabling policy framework • Availability of a strong seed system to produce certified seed potato
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 150 bags of 50 kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000=KES 105,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender-related opportunities	<p>Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing</p> <ul style="list-style-type: none"> • Chulu potato variety has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as Chulu potato variety • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Chulu is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Chulu potato variety is early maturing which means it has the potential providing stable supply of potato products to the markets and livelihoods to VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1- Ready for up-scaling
G: Contacts	KALRO-Tigoni,
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., John Onditi., Jane Muthoni., Nancy Ng'ng'a., Judith Oyoo., Miriam Mbiyu., Patrick Pwaipwai., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs


Research Gaps- Chulu

Certified Seed potato availability

Awareness creation through promotion

2.1.14 Potato variety/Advance clone 6C11

Technology Name	Potato variety/advance clone 6C11
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	Advance clone 6C11 is a red skin, creame flesh with shallow eyes, it is has white flowers annd shows level of drought/heat tolerannce. The clone is high yielding (30 - 40 tons/ha, resistant to late blight, suitable for processing chipping

	 <p><i>Advance Clone 6C11 tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i></p>
Justification	It is suitable for processing crisping and yields 30 to 40 tons/ha. It is tolerant to late blight and most potato viruses. Therefore, adoption of the new varieties will expand potato production into non- traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	ToTs, Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, Partners (CIP, NPCK, FAO, ICIPE, GIZ), Mobile phone text initiative, Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer, Workshops, Seminars, Meetings, trainings, Extension publications (posters/brochures/leaflets), Social platforms, Farmer Field and Business Schools (FFBS), Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Recruitment and support for SMEs for potato production • Field demonstrations on potato variety Shangi alongside existing local varieties • Use of good agricultural practices • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection

	<ul style="list-style-type: none"> • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion)Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges dissemination in	<ul style="list-style-type: none"> • Lack of information about the existence of variety/Non-the exposure of the end-user to a technology • Limited CIG based supportive seed system that would promote seed potato availability • Low publicity about varieties • Weak research- extension- farmer linkage to support dissemination
Suggestions addressing challenges for the	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for variety Shangi targeting grain traders through road shows • Capacity building of all value chain actors on production and value addition
Lessons learned upscaling, if any in	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • Partnership is important in technology dissemination • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Environmentally friendly, resilient and climate smart • Favourable weather • Availability of reliable market: domestic and regional • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES120,000 per acre
Estimated returns	Estimated output of 150 bags of 50 kg @KES 1500; total revenue KES 225,000 less costs of KES 120,000 = KES 105,000

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • Since it is highly demanded variety it will create opportunity for women in production, retailing, value addition and marketing • Potato advance clone 6C11 has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as of advance clone 6C11 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Potato advance clone 6C11 is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance clone 6C11 has the potential providing stable supply of potato products to the markets and livelihoods to VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Still under research
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Centre Director, KALRO-Tigoni


	P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO (Food and Agriculture Organization), Common Interest Groups (CIGs), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), NGOs

GAPS

Candidate for the national performance trials

Production of the breeder seed potato to be undertaken

2.1.15 Potato Advance clone IHC


Technology Name	Potato Advance clone IHC
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	<p>Advance clone IHC is purple skin with pale purple eyes, round shaped, medium eyes early to mid maturing, with a potential moderate yielding, suitable for table consumption, the flesh colour is white.</p> 

	<i>Advance Clone IHC tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i>
Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches to be used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc), workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • Limited CIG based supportive seed system • Limited publicity about varieties

	<ul style="list-style-type: none"> Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<p>Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS</p> <p>Scaling up participation of end-user in on-farm activities/adaptive research/extension activities</p>
Lessons learned in up-scaling, if any	<ul style="list-style-type: none"> Use of FFBS is effective in technology dissemination and adoption Involvement of farmers alone is not enough to support adoption, need to involve traders, processors, exporters and other actors in the value chain Partnership is important in technology dissemination Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Reliable markets Favourable weather Awareness and acceptability of the variety by target communities. Enabling policy framework (Seed, horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000=KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Pessimism expressed by farmers of new technology and the associated risks Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes Most farmer groups are composed of women and this may leave out the opinion and interests of men Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> Since it is expected to be a highly demanded variety it will create opportunity for women in production, retailing, value addition and marketing Potato advance clone IHC has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed VMGs have limited access to education, training and extension services

	<ul style="list-style-type: none"> • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as advance clone IHC • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Potato advance clone IHC is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance clone IHC has the potential of providing stable supply of potato products to the markets and livelihoods to VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development MOALD International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

2.1.16 Potato Advance clone 6B170

Technology Name	Potato advance clone 6B170
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	<p>Advance clone 6B170 is a medium tall potato plant with semi erect stems and dark green medium sized leaves. It is mid maturing with red tubers, resistant to late blight and suitable for fresh chips and table consumption. It has oblong shaped tubers with shallow eyes and purple flowers. The clone is high yielding (30 - 40 tons/ha).</p> <div>  </div> <p><i>Advance Clone 6B170 tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i></p>
Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToTs • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning


	<ul style="list-style-type: none"> • Mass media- e.g. Mkulima programme, Seeds of Gold, Smart Farmer • Workshops • Seminars, Meetings, trainings • Extension publications (posters/brochures/leaflets) • Social platforms • Farmer Field and Business Schools (FFBS) • Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Recruitment and support for SMEs for potato production • Field demonstrations • use of good agricultural practices • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • High marketing costs due to poor and undeveloped physical and marketing infrastructure • Selling by weight • Packaging seed potato in smaller units such as 10 or 20 kg for women, elderly and children • Limited CIG based supportive seed system • Limited publicity about varieties • Weak research-extension-farmer linkage to support dissemination

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions • Shortening the marketing chains by – forming producer and marketing groups/cooperatives • Find innovations in reducing production costs to encourage further production • Capacity building of all value chain actors
Lessons learned in up-scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption
	<ul style="list-style-type: none"> • Involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain • Partnership is important in technology dissemination • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Important in the local diet • Environmentally friendly, resilient and climate smart • There is availability of market: domestic and regional • Reliable markets • Favourable weather • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men
Gender related opportunities	<ul style="list-style-type: none"> • This variety creates employment for women in production, retailing, value addition and marketing • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Potato advance clone 6B170 has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths

	<ul style="list-style-type: none"> • Short cropping cycle allows production of several crops per year thus important in improving food and nutrition for the VMG
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed. VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as of advanced clone 6B170 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Potato advance clone 6B170 is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance clone 6B170 has the potential providing stable supply of potato products to the markets and livelihoods to VMGs • Since potato is nutritious particularly with the skin, it is a dietary option for the VMGs • Short cropping cycle allows production of several crops per year thus important in improving food and nutrition for the VMG • Fits well in major cropping patterns • Capacity building for the VMGs in agri-business will ensure better participation in value addition and trade
E: Case studies/profiles of success stories	
Success stories from previous similar Projects	Yet to be released
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
G: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783

	E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs

2.1.17 Potato Advance clone 1G70

Technology Name	Potato advance clone 1G70
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	<p>Advance clone IG70 is a tall potato plant with vibrant erect stems and dark green medium sized leaves. It has oval shaped tubers with medium eyes and profuse white flowers with cream flesh. The clone is high yielding (30 - 40 tons/ha). It is late maturing, it is highly resistant to late blight and other pests. It is suitable for fresh chips and has cream to white flesh.</p> <div>  </div> <p><i>Advance Clone IG70 tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i></p>

Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToTs • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer • Workshops • Seminars, Meetings, trainings • Extension publications (posters/brochures/leaflets) • Social media platforms • Farmer Field and Business Schools (FFBS) • Fairs and exhibitions
Critical/essential factors for successful promotion	<p>Functioning seed system</p> <p>Adequate quantities of good quality seed</p> <ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations on potato variety Shangi alongside existing local varieties • Use of good agricultural practices • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)- CARE Kenya (Farmer Input Promotion), Private investors


C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • High marketing costs due to poor and undeveloped physical and marketing infrastructure selling by weight • Packaging seed potato in smaller units such as 10 or 20 kg for women, elderly and children • Limited CIG based supportive seed system • Limited publicity about varieties • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for variety • Shortening the marketing chains by forming producer and marketing groups/cooperatives • Find innovations in reducing production costs to encourage further production • Capacity building of all value chain actors
Lessons learned in up-scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • Partnership is important in technology dissemination • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Important in the local diet • Environmentally friendly, resilient and climate smart • There is availability of market: domestic and regional • Reliable markets • Favourable weather • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • This variety creates opportunity for women in production, retailing, value addition and marketing • 1G70 has the potential for processing into crisps locally • Creating employment for women in processing and marketing Youth in packing and distribution and ready snacks for all ages but mainly school going children in the community
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs might not access the TIMP since it might not be available while needed for planting • Poorly delivery systems will hinder the VMGs from accessing the seeds in addition to limited sources of high quality seeds • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed. VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds of advance clone 1G70 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • Potentials exist for employment of VMGs in seed potato production, processing (whole peels, fresh cuts, crisps) and packaging • Since potato is nutritious particularly with the skin, it is a dietary option for the VMGs • Short cropping cycle allows production of several crops per year thus important in improving food and nutrition for the VMG • Fits well in major cropping patterns • Capacity building for the VMGs in agri-business will ensure better participation in value addition and trade
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Yet to be released

Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development (MOALD)
	International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs

2.1.18 Potato Advance clone 3C22

Technology Name	Potato advance clone 3C22
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	Advance clone 3C22 has a vibrant semi erect short to medium height stems and dark green medium sized leaves. It has round shaped white tubers with deep eyes. Has white flowers and cream flesh. The clone is high yielding (30 - 40 tons/ha). It is early maturing and highly resistant to late blight and other pests. It is suitable for crisping and table consumption.

	 <p><i>Advance Clone 3C22 tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i></p>
Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToTs • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD /Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer • Workshops • Seminars, Meetings, trainings • MOALD/Extension publications (posters/brochures/leaflets) • Social platforms • Farmer Field and Business Schools (FFBS) • Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Recruitment and support for SMEs for potato production
	<ul style="list-style-type: none"> • Field demonstrations • use of good agricultural practices • Effective agricultural extension services • Variety descriptors


Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion)Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • High marketing costs due to poor and undeveloped physical and marketing infrastructure • Selling by weight • Packaging seed potato in smaller units such as 10 or 20 kg for women, elderly and children • Limited CIG based supportive seed system • Limited publicity about varieties • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for variety • Shortening the marketing chains by – forming producer and marketing groups/cooperatives • Find innovations in reducing production costs to encourage further production • Capacity building of all value chain actors
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain, partnership is important in technology dissemination

	<ul style="list-style-type: none"> • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Availability of reliable market: domestic and regional • Favourable weather • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men
Gender related opportunities	<ul style="list-style-type: none"> • This variety creates employment for women in production, retailing, value addition and marketing • 3C22 has the potential for processing into crisps locally, creating employment for women in processing and marketing, youth in packing and distribution and ready snacks for all ages but mainly school going children in the community • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Potato advance clone 3C22 has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as potato advance clone 3C22 upon release • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain

	<ul style="list-style-type: none"> • There are chances of increased production leading to improved livelihoods for VMGs • Potato advance clone 3C22 is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance clone 3C22 has the potential providing stable supply of potato products to the markets and livelihoods to VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	-
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK)
	International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

2.1.19 Potato Advance clone: IG35

Technology Name	Potato advance clone: IG35
Category (i.e. technology,	Technology

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid-altitude and processing
What is it? (TIMP description)	<p>Advance clone IG35 is a tall potato plant with vibrant erect stems and dark green medium sized leaves. It has oval shaped tubers with shallow eyes. The clone is high yielding (30 - 40 tons/ha). It is late maturing, very high yielding, it is highly resistant to late blight and other pests. It is suitable for fresh chips and table consumption. It has cream flesh and purple flowers.</p>  <p><i>Advance Clone IG35 tubers and flower</i> <i>Source: Photos courtesy of Susan Otieno KALRO</i></p>
Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers</p> <p>Seed producing companies and SMEs</p> <p>Other research organizations/institutions (universities)</p>
Approaches to be used in dissemination	ToTs, Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD /Extension officers, Partners (CIP, NPCK, FAO, ICIPE, GIZ), Mobile phone text initiative, Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer, Workshops, Seminars, Meetings, trainings, Extension publications (posters/brochures/leaflets), Social platforms, Farmer Field and Business Schools (FFBS), Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Recruitment and support for SMEs for potato production • Field demonstrations on potato variety


	<ul style="list-style-type: none"> • Use of good agricultural practices • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<p>Ministry of Agriculture & Livestock Development (MOALD)</p> <p>CIP (International Potato Centre) – Collaborative research on potato variety development</p> <p>ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection</p> <p>FAO (Food and Agricultural Organization)- Co-sharing of resources and networking and knowledge management</p> <p>CIGs (Common Interest Groups)- back stopping the technologies at grass root levels</p> <p>GIZ- Nutrition and potato utilization by the communities</p> <p>NGOs (Non-governmental organization)</p> <p>CARE Kenya-Farmer Input Promotion</p> <p>Private investors</p>
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • High marketing costs due to poor and undeveloped physical and marketing infrastructure • Selling by weight • Packaging seed potato in smaller units such as 10 or 20 kg for women, elderly and children • Limited CIG based supportive seed system • Limited publicity about varieties • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for variety
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain, Partnership is important in technology dissemination

	<ul style="list-style-type: none"> • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • There is availability of reliable market: domestic and regional • Favourable weather • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	<ul style="list-style-type: none"> • Estimated output of 160 bags of 50 kg @ KES 1500; total revenue • KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Most farmer groups are composed of women and this may leave out the opinion and interests of men
Gender related opportunities	<ul style="list-style-type: none"> • Short cropping cycle allows production of several crops per year thus important in improving food and nutrition for women and youth • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Potato advance clone IG35 has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as potato advance clone IG35 • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs • Potato advance cloneIG35 is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance cloneIG35 has the potential providing stable supply of potato products to the markets and livelihoods to VMGs since potato is nutritious particularly with the skin, it is a dietary option for the VMGs • Short cropping cycle allows production of several crops per year thus important in improving food and nutrition for the VMG • Fits well in major cropping patterns • Capacity building for the VMGs in agri-business will ensure better participation in value addition and trade
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3 -requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE)
	FAO (Food and Agriculture Organization)

	Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
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2.1.20 Potato Advance clone IHB

Technology Name	Potato advance clone IHB
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low farm productivity (below 7 tons/ha) and shortage of varieties for mid altitude and processing
What is it? (TIMP description)	<p>Advance clone IHB is a short to medium height stems and dark green large sized leaves. It has oval shaped white tubers with light purple shallow eyes. Has purple flowers and cream flesh. The clone is high yielding (30 - 40 tons/ha). It is mid maturing and highly resistant to late blight and other pests. It is suitable for chips and table consumption.</p>  <p><i>Advance Clone IHB tubers and flower</i> Source: Photos courtesy of Susan Otieno KALRO</p>
Justification	Adoption of new varieties will expand potato production into non-traditional potato producing areas. Increasing the basket of choices for the consumer and growing the industry for processing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches to be used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, Partners (CIP,

	NPCK, FAO, ICIPE, GIZ), Mobile phone text initiative, Farmer to farmer peer learning, Mass media- e.g Mkulima programme, Seeds of Gold, Smart Farmer, Workshops, Seminars, Meetings, trainings, Extension publications (posters/brochures/leaflets), Social platforms, Farmer Field and Business Schools (FFBS), Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Recruitment and support for SMEs for potato production • Field demonstrations on potato variety • use of good agricultural practices • Effective agricultural extension services • Variety descriptors
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)- CARE Kenya: Farmer Input Promotion • Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to a technology • High marketing costs due to poor and undeveloped physical and marketing infrastructure • Selling by weight • Packaging seed potato in smaller units such as 10 or 20 kg for women, elderly and children not available • Limited CIG based supportive seed system • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Market promotions for variety

	<ul style="list-style-type: none"> • Capacity building of all value chain actors
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain, Partnership is important in technology dissemination • Use of roadshows and mass media communication will upscale the awareness creation of the variety
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Availability of reliable market: domestic and regional • Favourable weather • Awareness and acceptability of the variety by target communities. • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Pessimism expressed by farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> • Since it is highly demanded variety it creates opportunity for women in production, retailing, value addition and marketing • Potato advance clone IHB has the potential for processing into crisps locally, creating employment for women in processing and youth in packing and distribution • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited access and control to production resources such as land, knowledge, information, extension training, credit and quality seed • VMGs have limited access to education, training and extension services • Limited participation in decision making at community and County level • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seeds such as advance clone IHB • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • There is potential of VMGs getting employment at various nodes of the value chain • There are chances of increased production leading to improved livelihoods for VMGs

	<ul style="list-style-type: none"> • Potato advance clone IHB is high yielding hence there is a potential of increasing food security and nutrition for VMGs • Potato advance clone IHB has the potential providing stable supply of potato products to the markets and livelihoods to VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Susan Otieno., Moses Nyongesa., Jane Muthoni., John Onditi., Miriam Mbiyu., Judith Oyoo., Nancy Nganga., Patrick Pwaipwai., and Jackson Kilonzi., John Faida Kelele Joseph Ngaruiya., Ann Namusonge and Cecilia Kawira
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs

2.1.21 Potato Variety descriptors

Technology name	Potato Variety descriptors
Category (i.e. technology, innovation or management practice)	Management practise

A: Description of the technology, innovation or management practice	
Problem to be addressed	Variety development process takes a long time to realize a commercial variety. Once commercialized, each variety requires to be uniquely identified using a set of traits contained in a variety descriptor. Yet, many potato commercial varieties lack descriptors and when available, they are not easily accessed to facilitate use of the variety either as plant genetic resource by breeders in development of new varieties. Absence of descriptors hinders accurate cataloging and documentation of varieties.
What is it? (TIMP description)	<ul style="list-style-type: none"> • This is a list that consists of an initial set of characterization and evaluation descriptors for potato • This key set of strategic descriptors, together with passport data, becomes the basis for the global accession-level information system on Global Information on Germplasm Accessions (GIGA) • It facilitates access to and utilization of potato accessions held in genebanks and does not preclude the addition of further descriptors, should data subsequently become available • Key features of a potato descriptor are: passport characteristics; plant characteristics; tuber characteristics; utilization characteristics; tuber characteristics; resistance to pests and diseases.
Justification	A descriptor list provides information in an international agreed format and thereby produces a universally understood 'language' for plant genetic resources data. The adoption of this scheme for data encoding will produce a rapid, reliable, and efficient means for information storage, retrieval, and communication, and will assist with the utilization.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Breeders/institutions (universities) • Agripreneurs • Farmers • Curators
Approaches used in dissemination	Workshops; Seminars, Meetings, trainings; Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Technical knowledge on funding by government • Signed Establishment Agreements • Government support
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • KALRO to publish descriptors for public varieties varieties • CIP (International Potato Centre) – Collaborative research on potato variety development
C: Current situation and future scaling up	
Counties where already promoted if any	To be determined
Counties where TIMP will be upscaled	To be determined

Challenges in dissemination	Lack of Technical capacity Descriptors for public varieties in Kenya yet to be compiled into a single catalogue
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • National and County government support towards technical capacity development for breeders • Establishment of equipment • Strengthened research networks with CGIARs
Lessons learned in upscaling if any	To be determined
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Enabling policy environment Farmer willingness and acceptability • Timely availability of funds
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	None
Gender related opportunities	To be determined
VMG issues and concerns in development, dissemination, adoption and scaling up	None
VMG related opportunities	To be determined
E: Case studies/profiles of success stories	
Success stories	To be determined
Application guidelines for users	<ul style="list-style-type: none"> • Bioversity International (2007) Guidelines for the development of Crop Descriptor lists • Bioversity Technical Bulletin Series. Bioversity International, Rome, Italy,xii+72p
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires	Ready for upscaling

validation; 3-requires further research)	
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa, Susan Otieno., John Faida., Nancy Ng'ang'a, Judith Oyoo, , Patrick Pwaipwai, Miriam Mbiyuand Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs (CARE Kenya): (Farmer Input Promotion) County governments (CGs) USAID FtF (United States Agency for International Agriculture- Feed the Future) NGOs

2.1.22 Potato Suitability Map

Technology Name	Potato Suitability Map
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Farmers' decisions on which variety to grow is often influenced by market forces rather than considering variety suitability for the locations where they do farming. Therefore, the varieties they grow can underperform leading to low yields.
What is it? (TIMP description)	A suitability map is a tool that provides information on which crop varieties are best suited for cultivation in a specific agro-ecological location given prevailing biophysical conditions of soils and climate and the need to use natural resources as efficiently as possible.

	<p style="text-align: center;">MAP SHOWING POTATO GROWING AREAS IN KENYA</p> <p>KEY</p> <ul style="list-style-type: none"> ■ Established major growing area ■ Emerging major growing area ■ Minor but Potential growing areas ★ Mainly in Hill Masses
Justification	Access to information will drive up/enhance adoption of new varieties and expand area under potato production. A well developed potato industry exists in Kenya with over one million farmers who require information on optimal potato production guidelines.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	Smart Farmer, Lead farmers, Workshops, Seminars, Meetings, trainings, Extension publications (posters/brochures/leaflets), Social platforms, Farmer Field and Business Schools (FFBS), Fairs and exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Functioning seed system • Adequate quantities of good quality seed • Field demonstrations on potato variety • Owning a smartphone • Access to internet • Effective agricultural extension services

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - policy issues • CIP (International Potato Centre) – Collaborative research on potato variety development • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) – supply of inputs • Private investors in digital platforms
C: Current situation and future scaling up	
Counties where already promoted, if any	none
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the variety/Non-exposure of the end-user to this management practise • High marketing costs due to poor and undeveloped physical and marketing infrastructure
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field day, road shows and FFBS • Scaling up participation of end-user in on-farm activities/adaptive research /extension activities • Market promotions for variety • Capacity building of all value chain actors
Lessons learned in up-scaling, if any	Web-based interactive application to provide information on variety suitability useful tool in reaching famers
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Availability of reliable market: domestic and regional • Favourable weather • Awareness and acceptability of the management practice by the community • Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and scaling up	Low literacy levels among female gender compared to male gender, affecting adoption of such a tool due to low understanding
Gender related opportunities	<ul style="list-style-type: none"> • Youth friendly employment opportunities in digital platforms • Self employment on sale of phones

	<ul style="list-style-type: none"> • Service provision to the low literate community members at a small fee
VMG issues and concerns in development and dissemination	None
VMG related opportunities	SMEs in enrolment on digital platforms Capacity building for the VMGs in agri-business will ensure better participation in value addition and trade
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	-
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa, Susan Otieno, Nancy Ng'ang'a, Judith Oyoo, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs

2.1.23 Genetic/DNA Fingerprinting

Technology Name	Genetic/DNA Fingerprinting
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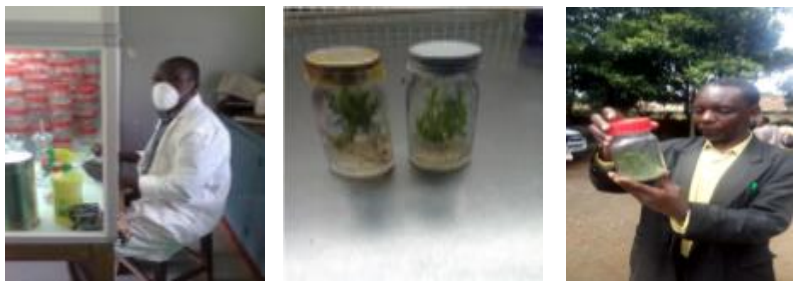
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Varietal mix-ups during early generation seed bulking often leads to lack of uniformity and risk of rejection during regulatory inspections. If unchecked results in quality issues of produce reaching the market.
What is it? (TIMP description)	Genetic/DNA fingerprinting is used to identify inherited genetic traits responsible for traits that confer uniqueness to varieties and which can be used to identify them. Using this technique, breeders can more quickly and accurately identify varieties
Justification	Seed regulations provide for varietal purity as an essential aspect of the standards to be observed by sector players. In early stages of seed development, visual confirmation of varietal purity is inadequate hence the need for genetic fingerprinting that avails fidelity and accuracy in identification.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Seed producing companies and SMEs Breeders Scientists
Approaches to be used in dissemination	Workshops, Seminars, Meetings, trainings, Extension publications (posters/brochures/leaflets)
Critical/essential factors for successful promotion	National and County government support Friendly policy support environment Technical capacity
Partners/stakeholders for scaling up and their roles	CIP (International Potato Centre) – Collaborative research on potato variety development Kenya Plant Health Inspectorate Service (KEPHIS)
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMP will be up-scaled	-
Challenges in dissemination	Availability of equipment locally Low technical capacity
Suggestions for addressing the challenges	NARS strong network base to leverage on each other
Lessons learned in up-scaling, if any	Partnership is important in technology accessibility
Social, environmental, policy and market	Awareness and acceptability of the management practice by the community

conditions necessary for development and up-scaling	Enabling policy framework (Seed, Horticulture, Policies)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and scaling up	Low literacy levels among the genders, affecting adoption of such a tool due to low understanding
Gender related opportunities	Youth friendly employment opportunities in digital platforms Female gender favored opportunities to receive scholarships for further studies to build technical capacity
VMG issues and concerns in development and dissemination	None
VMG related opportunities	Technical capacity opportunities for further studies
E: Case studies/profiles of success stories	
Success stories from previous similar projects	yet to be released
Application guidelines for users	-
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., .Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE)

	FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs
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2.2 TIMPS on Seed Systems

2.2.1 Tissue culture

Technology Name	Tissue culture
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inadequate supply of breeder seed potato of improved varieties
What is it? (TIMP description)	<p>Tissue culture –involves <i>in vitro</i> aseptic culture of plant cells, plant tissues and organs for the purpose of obtaining growth. It is the beginning stage of increasing readily quantities of disease free planting materials within a very short time.</p> <div>  </div> <p><i>Tissue culture facility, the plantlets in a kilner jar ready for hardening</i> <i>Source: Photos courtesy of Patrick Pwaipwai, KALRO</i></p>
Justification	This innovation enables achievement of quantities of early generation seed (breeder seed) of newly released varieties within a very short time, which can further be multiplied under guidelines of Seed and Plant Variety Act, to produce certified seed potato.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches to be used in dissemination	Specialized training of technologists, Workshops, Seminars, Meetings, trainings, FFBS, Promotional materials (posters/brochures/leaflets), On farm and on station research trails and demonstrations , mass media, promotional materials, agricultural innovation platforms

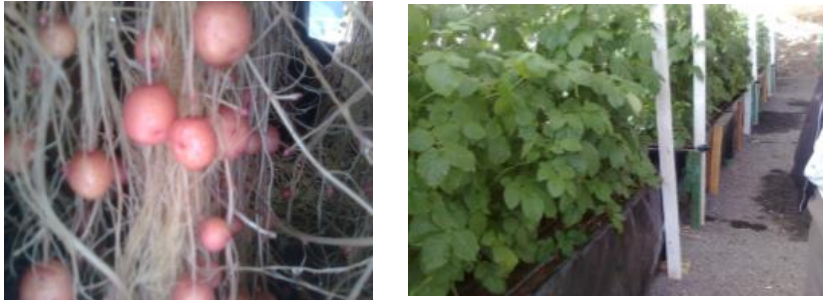
Critical/essential factors for successful promotion	<p>Recruitment and support for private seed companies and SMEs to enter seed production; value addition and product diversification</p> <p>Well organized CIGs and seed producers</p> <p>Adoption and demand for early generation seed</p> <p>funding by government/development partners to promote production and distribution of seed of selected potato varieties</p>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to undertake adaptive research on current and other new varieties • Ministry of Agriculture & Livestock Development – policy issues • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) – supply of inputs • Private investors
C: Current situation and future scaling up	
Counties where already promoted, if any	Not widely distributed; only 6 companies (3 public; 3 private) currently involved in potato TC in Kenya
Counties where TIMPs will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of potato innovation platforms • Most growers are not aware of the technology • Limited capacity
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Scaling up participation of end-user in technology development, on-farm activities/adaptive research/extension activities • Promoting awareness among farmers about possibility of investment • Well organized farmer groups/CGs • Good marketing models for seed potato • Support and good will from national and county governments • Strong collaborative links between stakeholders in Potato value chain • Trained and experienced staff/manpower
Lessons learned in up-scaling, if any	<ul style="list-style-type: none"> • Growing demand for basic and certified seed due to expanding potato production • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption

	<ul style="list-style-type: none"> • Need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Enabling policy environment such as: Enabling policy environment such as: The Seeds and Plant Varieties (Seeds) Regulations 2016. Legal Notice No. 220. Legal Supplement No. 82. Kenya Gazette Supplement No. 205. December 2016. • Timely inspection by regulatory bodies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land is mainly owned by men and therefore women are usually excluded in decision making or have no access to the land resources to produce the potatoes • Women and stakeholders might not get the seedlings when needed • Women might not be aware of the TIMP due to illiteracy and limited mobility due to their busy schedule • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Pessimism expressed by farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> • If adopted women will be able to have first growing potatoes • There will also be employment for women and youth due to increased production • There will be increased food security and nutrition for women and household members
VMG issues and concerns in development, dissemination, adoption and scaling	<ul style="list-style-type: none"> • Dissemination methods and documents that are not always easy to understand or access • VMGs have low technical-know how to access/use the technology
VMG related opportunities	<ul style="list-style-type: none"> • Tissue culture if adopted would improve production of potatoes for VMGs hence create employment • Short courses training to improve the technical know how of the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Several public and private institutions have invested in the technology and are receiving technical support from NARS (KALRO, JKUAT, KEPHIS)

Application guidelines for users	Pwaipwai P, Wakahiu L, Ongele J (2016) Edited by: Oyoo J and Nyongesa M Rapid multiplication of Seed Potato through Tissue Culture. KALRO Brochure Information Series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa, Susan Otieno, Nancy Ng'ang'a, Judith Oyoo, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi
Partner organizations	MOALD CIP FAO CIGs USAID FtF GIZ NGOs (CARE Kenya): (Farmer Input Promotion)

2.2.2 Aeroponics

Technology name	Aeroponics
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inadequate supply of breeder seed potato of improved varieties
What is it? (TIMP description)	Aeroponics is a technique in which production of potato minitubers is performed in a soil-less culture environment. The system ensures production of disease free tubers by eliminating contact between plants with soil. The <i>in-vitro</i> plantlets produced through tissue culture are suspended on specially designed support structures which encloses roots in dark chambers. The nutrients in solution form are supplied directly to plant roots by way of misters connected to an automated system pumping which is programmed.

	
Justification	The system ensures production of disease free tubers by eliminating contact between plants with soil. It is a climate smart technology which promotes water use efficiency; where water recycling done; system is in an enclosure hence evaporation is significantly reduced; it is farmer accepted; market demand; high opportunity for business incubation
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers /Lead farmers, Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches used in dissemination	Farmer Participatory Evaluation exercises, MOALD/Extension officers, Partners (CIP, NPCK, FAO, ICIPE, GIZ), Mobile phone text initiative, Small seed pack model, Farmer to farmer peer learning, Mass media – “Mkulima programme”, Workshops, Seminars, Meetings, trainings, Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	Well organized seed potato SMEs funding by government to promote production and distribution National and County government support


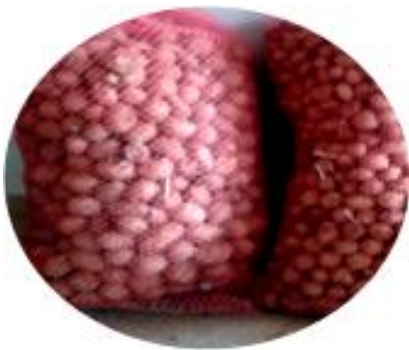
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • KALRO to undertake adaptive research on current and other new varieties • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • KEPHIS (Kenya Plant Health Inspectorate Services) – regulate and certify seed potato produced. • Private seed growers – to grow and multiply certified seed potato
C: Current situation and future scaling up	
Counties where already promoted if any	KALRO Tigoni, Kiambu, Nairobi, Nyandarua
Counties where TIMP will be upscales	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Limited and unorganized production and marketing channels • Favorable policy environment/ support • Limited awareness by potato stakeholders
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Scaling up participation of end-user in technology development, on-farm activities/adaptive research/extension activities • Promoting awareness among farmers about the loss of varietal vigor associated with recycling of saved seed for many generations can also increase demand for certified seed. • Good seed potato system • Well organized farmer groups/CIGs • Good marketing models for seed potato • Support and good will from national and county governments • Strong collaborative links between stakeholders in Potato value chain • Trained and experienced staff/manpower
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • Prospects in employment
Social, environmental, policy and market	<ul style="list-style-type: none"> • Availability of reliable markets • There is availability of seed potato market: domestic and regional

conditions necessary for development and upsacing	<ul style="list-style-type: none"> Enabling Policy Environment such as: Enabling policy environment such as: The Seeds and Plant Varieties (Seeds) Regulations 2016. Legal Notice No. 220. Legal Supplement No. 82. Kenya Gazette Supplemnt No. 205. December 2016.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of setting up Aeroponics and operationalizing (excluding purchase or leasing land)/fixed and variable costs .approx KSh 1,500,000 for 15m by 5m aeroponics unit
Estimated returns	Estimated output of 50,000 minitubers @ KES 30.00; total revenue KES 1,500,000 less costs. Profit =0 for first season but Ksh 1.5 million in the second season
Gender issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources Pessimism expressed by farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> There will be increased employment opportunities in production, processing and marketing There will be increased production of potatoes leading to improved food and nutritional security for women and entire household There will be increased employment for women and the youth Women will get appropriate information relating to quality potato seeds leading to production of quality potatoes
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Dissemination methods and documents that are not always easy to understand or access VMGs have low technical-know how to access/use the technology
VMG related opportunities	<ul style="list-style-type: none"> Tissue culture if adopted would improve production of potatoes for VMGs hence create employment Short courses training to improve the technical know how of the VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Pwaipwai P, Ngaruiya j Wakahiu L, Ongele J (2016) Edited by: Oyoo J and Nyongesa M. Aeroponics Systems. KALRO Brochure Information Series.
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires	Ready for up-scaling

validation; 3-requires further research)	
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs (CARE Kenya)

2.2.3 Rooted Apical Cuttings (RACs)

Technology name	Rooted Apical Cuttings (RACs)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	There is done to increase the production of certified seed for popular varieties meaning farmers tend to recycle seed or rely on sources that do not guarantee quality hence poor yields
What is it? (TIMP description)	Rooted apical cuttings - is a technology for increasing seed production at farm level within a short period through use of seedlings obtained by rooting apical shoots from tissue culture plantlets. The seedlings are then established outdoors on raised beds, protected from direct weather elements until they are established. Production guidelines follow the normal way of growing potatoes as given by Nyongesa et al.(2016)

	 
Justification	It is a market demanded technology; farmer accepted and adaptable to strategies for improving seed quality at farm level; potential system for rapidly increasing high quality seed potato in a short period compared to the period required to obtain certified seed; high opportunity for business incubations.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Small seed pack model • Farmer to farmer peer learning • ICT platform (Viazi soko) • Trade fair • Mass media – “Mkulima programme” • Workshops • Seminars, Meetings, trainings • Promotional material (posters/brochures/leaflets/Variety catalogue)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for private seed companies and SMEs to enter seed production • Decentralized/satellite seed bulking system • Favorable policy support • funding by government to promote production and distribution of seed of selected potato varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to undertake adaptive research on current and other new varieties • Ministry of Agriculture & Livestock Development- Extension and Capacity Building

	<ul style="list-style-type: none"> • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion) • KEPHIS (Kenya Plant Health Inspectorate Services) – regulate and certify seed potato produced • Private seed growers – to grow and multiply certified seed potato
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nandi, Nyeri, Bungoma, Nakuru and Kiambu
Counties where TIMP will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Weakening seed potato sector in early generation seed potato multiplication, distribution and extension services. • High seed potato cost; KES 15 (USD 15 cents) per piece • Sensitive to water stress. Requires irrigation to establish a crop from rooted apical cuttings. • Limited access to crop agronomic packages • Lack of capacity for technical backstopping
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Scaling up participation of end-user in technology development, on-farm activities/adaptive research/extension activities • Promoting awareness among farmers about through trainings • Support and good will from national and county governments • Strong collaborative links between stakeholders in potato value chain • Trained and experienced staff/manpower
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Growing demand for basic and certified seed due to expanding potato production • Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Favorable weather • Available and reliable seed potato markets: domestic and regional • Enabling policy environment such as: The Seeds and Plant Varieties (Seeds) Regulations 2016. Legal Notice No. 220. Legal Supplement No. 82. Kenya Gazette Supplement No. 205. December 2016.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	-
Estimated returns	Estimated output of 200 bags of 50 kg @KES 3750(cost of basic seed); total revenue KES 750,000,(200* 3750 per 50 kg bag) less operational costs
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources • Pessimism expressed by farmers of new technology and the associated risks affects adoption of technologies
Gender related opportunities	<ul style="list-style-type: none"> • There is the potential of creating employment for women and youth in harvesting, sorting, grading, packing and marketing • Trading in seed potatoes will be profitable since seed potato has very high demand • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Lack of participation by some VMGs in decision making hence not benefitting from the technology • Dissemination methods and documents that are not always easy to understand or access • VMGs have low technical-know how to access/use the technology
VMG related opportunities	<ul style="list-style-type: none"> • Encourage participation by the VMGs in decision making hence enable them to benefit from the technology • RACs if adopted would improve production of potatoes for VMGs hence create employment • Short courses training to improve the technical know how of the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<p>A young farmer who received training on use of rooted apical cuttings started a seed potato venture with less than 500 cuttings in 2019, by 2021 the seed business had picked up after several seasons of field bulking of the initial seed tubers from the RACs. Supported by KALRO, Nyandarua County Government and other actors, the seed potato initiative in the county has grown and attracted more young people thus creating employment for several young entrepreneurs.</p> <p>https://potatocongress.org/wp-content/uploads/2020/12/Apical-Rooted-Cuttings-of-Potatoes-Revolutionized.pdf</p>
Application guidelines for users	Oyoo, J. , Ng'ang'a,N., Otieno ,S., Pwaipwai, P., Mbiyu, M., Lung'aho, C., and Nyongesa M (2018) Rooted Apical Cuttings Technology for timely accessibility and availability of high Quality Seed Potato. KALRO Brochure Information Series.

F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Nancy Ng'ang'a., Susan Otieno., Judith Oyoo, Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs (CARE Kenya)

2.2.4 Sand ponics

Technology name	Sand ponics
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inadequate supply of breeder seed potato of improved varieties
What is it? (TIMP description)	Sand ponics involves production of minitubers in a sterilized sand medium. The system involves use of river sand which is thoroughly cleaned with clean water, and sterilized with by steam or disinfectants such as sodium hypochlorite (jik). The cleaned sand is then placed in a specially designed wooden support structures (troughs). <i>In-vitro</i> plantlets produced through tissue culture are hardened for two weeks then planted on the sand in these structures at a spacing of 10 cm by 10 cm or 15 cm by 15 cm. The plants are supplied with artificial nutrients in solution form delivered via misters from a nutrient tank aided by an automated system.

Justification	The system ensures production of disease free tubers by eliminating pathogens in the growth medium. This is a climate smart technology which promotes efficient use of water because water is recycled; use of timers ensures right amount of water is applied to the crop and wastage is avoided; the system is enclosed hence water loss is reduced; farmer accepted; market demand; high opportunity for business incubation
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Agripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • MOALDFLI/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Small seed pack model • Farmer to farmer peer learning • Mass media – “Mkulima programme” • Workshops • Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support of private seed companies and SMEs to seed potato production business • Decentralized/satellite seed bulking system • funding by government to promote production and distribution of seed of selected potato varieties • Technical capacity for implementation
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • KEPHIS (Kenya Plant Health Inspectorate Services) – regulate and certify seed potato produced. • Private seed growers – to grow and multiply certified seed potato
C: Current situation and future scaling up	

Counties where already promoted if any	Kiambu, Nyandarua
Counties where TIMP will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Weakening seed potato sector in seed multiplication, distribution and extension services. • Inaccessibility and low awareness by end-users of this technology
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Scaling up participation of end-user in technology development, on-farm activities/adaptive research/extension activities • Promoting awareness among farmers about the loss of varietal vigor associated with recycling of saved seed for many generations can also increase demand for certified seed. • Support and good will from national and county governments • Strong collaborative links between stakeholders in Potato value chain • Trained and experienced staff/manpower
Lessons learned in upscaling	<ul style="list-style-type: none"> • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of seed potato market: domestic and regional market • Enabling policy environment • Favorable weather
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women might not have been aware of the TIMP due to illiteracy and limited mobility due to their busy schedule • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources • Pessimism expressed by women farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> • There is the potential of creating employment for women and youth in harvesting, sorting, grading, packing and marketing • Trading in potato seeds will be profitable since the demand is usually high especially during the planting season

	<ul style="list-style-type: none"> • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Lack of participation by some VMGs in decision making hence not benefitting from the technology • Dissemination methods and documents that are not always easy to understand or access • VMGs have low technical-know how to access/use the technology
VMG related opportunities	<ul style="list-style-type: none"> • Encourage participation by the VMGs in decision making hence enable them to benefit from the technology • Sandponics if adopted would improve production of potatoes for VMGs hence create employment • Short courses training to improve the technical know how of the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	Otieno, S., Mbiyu M, Oyoo J, Nyongesa M, Onditi J, Ngaruiya J, and Lungaho C (2018) On farm stem cutting for clean potato seed production. KALRO Brochure Information Series.
G: 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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo, Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • NGOs (CARE Kenya): (Farmer Input Promotion)

	<ul style="list-style-type: none"> USAID FtF (United States Agency for International Agriculture-Feed the Future)
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2.2.5 Positive Seed selection

Technology name	Positive Seed selection
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato production due use of farm-saved seed potato of undetermined quality
What is it? (TIMP description)	Positive seed selection- is selection of the healthy looking plants exhibiting vigorous growth to be used as the source of seed potato for the next season. By doing so, the number of sick plants in the next crop is reduced significantly.
Justification	Potato is among the key food security crops alongside rice, maize, wheat and beans identified under the big four agenda. Positive seed selection ensures timely availability and accessibility of high quality seed potato at farm level, ensuring reduced spread of diseases and pests, leading to high yields, making the country food secure and able to attain the big four agenda, Kenya Vision 2030 and SDGs.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Potato farmers Agripreneurs Other research organizations/institutions (universities) Processors (Deeper Industries ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods) Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Participatory Evaluation exercises On-farm demonstration Field days Agricultural shows MOALD/Extension officers Partners (CIP, NPCK, FAO, ICIPE, GIZ) Mobile phone text initiative Farmer to farmer peer learning Mass media- e.g. Mkulima programme, Smart Farmer, seeds of Gold Workshops, Seminars, Meetings, trainings Promotional materials (posters/brochures/leaflets) Social platform – twitter, google apps, Facebook

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of positive seed selection • Establishment of FFBS on Positive seed selection
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion)
C: Current situation and future scaling up	
Counties where already promotes if any	Nyanadarua, Elgeyo Marakwet, Bungoma, Narok, Nandi, Kiambu, Nyeri
Counties where TIMP will be promoted	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	Big challenge between information availability and accessibility Non-exposure of the end-user to positive seed selection
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – positive seed selection • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Important in the local dietEnvironmentally friendly resilient and climate smart. • There is availability of market: domestic and regional market • Enabling policy environment such as: enabling policy environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women might not have be aware of the TIMP due to illiteracy and limited mobility due to their busy schedule

adoption and upscaling	<ul style="list-style-type: none"> • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources • Pessimism expressed by farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> • Short cropping cycle allows production of several crops per year improving food and nutrition for the women and youth • Trading in potato seeds is profitable since seeds are usually in high demand during every planting season increasing income for women and youth • There is the potential of creating employment for women and youth in harvesting, sorting, grading, packing and marketing • There is potential of improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easily understood by VMGs • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar project	The technique has been widely promoted in major potato growing counties since 2003 and it is widely used by farmers to manage seed quality issues related to seed degeneration caused by potato viruses
Application guidelines for users	
G: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
F: Contacts	
Contacts	<p>Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org</p>

Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Bayer Crop science

2.2.6 Satellite seed potato bulking

Technology name	Satellite seed potato bulking
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Acute seed potato shortage for popular varieties Weak partnership linkages in seed potato value chain
What is it? (TIMP description)	<p>This is a system aimed at promoting and decentralizing seed potato production through organized and registered Seed CIGs. The CIGs are trained on seed potato production guidelines, licensed to use KALRO License for two seasons to produce certified seed potato, contribute land, labor and security to the project and meets all the KEPHIS inspection and certification costs while the KALRO may contribute the initial stocks of basic seed potato. The certified seed potato produced is sold directly to seed potato growers who multiply further before selling to ware potato producers.</p>  <p><i>Seed potato crop in Uasin Gishu County</i> <i>Source: Photos courtesy of Judith Oyoo KALRO</i></p>

Justification	Decentralized Seed potato bulking (satellite centres) – Timely accessibility and availability of certified seed potato is very important in attainment of food nutrition and security in the Country, create employment opportunities along the seed potato value chain in production, processing, and marketing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	FarmersAgripreneurs Seed producing companies and SMEs Other research organizations/institutions (universities) Processors (Deeper Industries Ltd; Propac Ltds, Sereni Fries Ltds)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Small seed pack model • Farmer to farmer peer learning • Mass media – “Mkulima programme” • Workshops • Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for private seed companies and SMEs to enter seed production • Decentralized/satellite seed bulking system • Linked to certified suppliers of basic seed potato for continuous renewal of the seed • Infrastructure including store and grader • Technical knowledge on seed potato production • Mandatory inspection and certification for quality control • funding by government to promote production and distribution of seed of selected potato varieties
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • KALRO to undertake adaptive research on current and other new varieties • Ministry of Agriculture & Livestock Development -Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion)

	<ul style="list-style-type: none"> • KEPHIS (Kenya Plant Health Inspectorate Services) – regulate and certify seed potato produced. • Private seed growers – to grow and multiply certified seed potato
C: Current situation and future scaling up	
Counties where already promoted if any	Promoted in Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu Counties
Counties where TIMP will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Delayed KEPHIS services as a result of unpaid KEPHIS fees by CIGs • Weakening seed potato sector in seed multiplication, distribution and extension services. • Weak CIG leadership causing conflicts and disintegration of groups • Lack of capacity in CIGs on entrepreneurship
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • National and County government support to fortify CIGs to establish as registered seed merchants • Trained and experienced staff/manpower in KEPHIS service provision as private seed inspectors • Capacity building in entrepreneurship and group dynamics • Aggressive awareness creation through field days, fliers, mass media and social platforms
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • The need for prompt payment of KEPHIS charges to fast-track subsequent service provision • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption, need to involve traders, processors and exporters and other actors in the value chain • National and County government support is very important for the success of a project/technology
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of seed potato market: domestic and regional market • Enabling policy environment such as: Enabling policy environment such as: The Seeds and Plant Varieties (Seeds) Regulations 2016. Legal Notice No. 220. Legal Supplement No. 82. Kenya Gazette Supplement No. 205. December 2016. • Farmer willingness and acceptability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of a bag of certified basic seed potato 50 kg KES. 3,500 @ 18 bags per acre (KES 63,000) including other costs total KES 120,000 per acre
Estimated returns	Estimated output of 200 bags of 50 kg @ KES 1500; total revenue KES 300,000 less costs = KES 180,000
Gender issues and concerns in development,	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality potato seeds • Women have been having low yields due to poor quality of seeds as they have been using recycled seeds

dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The training materials and strategies might not be favorable to women farmers who might be semi –illiterate • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women might not be aware of the TIMP due to illiteracy and limited mobility due to their busy schedule
Gender related opportunities	<ul style="list-style-type: none"> • Potato seeds have the potential to create employment for women and youth in harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easily understood by VMGs • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories	The concept of Seed CIGs has been piloted in 6 Counties (involving two CIGs per county) in a process which included CIG recruitment by the respective county agricultural officers, trained on seed potato production guidelines and allowed to use KALRO license for two seasons to produce certified seed potato. These CIGs produced 53.95 tons of certified seed potato (1,079 bags worth Ksh 3.2 million).
Application guidelines for users	Seed Potato and Production Guidelines http://www.kephis.org › docs › seedpotatobooklet PDF
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783

	E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • NGOs (CARE Kenya): (Farmer Input Promotion) • County governments (CGs) • USAID FtF (United States Agency for International Agriculture-Feed the Future) • NGOs (CARE Kenya): (Farmer Input Promotion)

2.2.7 Quality Declared Seed

Technology name	Quality Declared Seed
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato yields due to use of farm-saved seed potato of undetermined quality
What is it? (TIMP description)	Quality Declared Seed (QDS) is seed in a quality control system, introduced by FAO, whereby 10% of the seed fields and lots are checked by an autonomous quality control agency and the remainder by the seed production organization (Louwaars, et al., 1996). This is seed which is not processed through a formal seed system, but in which quality is assured through the reputational identity of the original source of initial stock.
Justification	Kenya produces a lot of potatoes every season on acreage of approximately 160,000 ha. These growers require high quality seed potato yet the formal seed system supply is estimated to be 10% of the effective demand, leaving the 90% seed demand to be supplied by the informal seed system. QDS technology will assure high quality of disease free planting material, contributing to better potato yields of high quality
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs

	<ul style="list-style-type: none"> • Other research organizations/institutions (universities) • Processors (Deeper Industries Ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods) • Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g. Mkulima programme, Smart Farmer, seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social platform – twitter, google apps, Facebook
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of positive seed selection • Establishment of FFBS on Positive seed selection
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs
C: Current situation and future scaling up	
Counties where already promotes if any	To be determined
Counties where TIMP will be promoted	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<p>Non-exposure of the end-user to positive seed selection</p> <p>Acceptability by the national regulatory organization</p>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – QDS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Favorable policy support

Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of reliable markets: domestic and regional market • Enabling policy environment • Farmer willingness to adopt the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality potato seeds • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources
Gender related opportunities	<ul style="list-style-type: none"> • Potato seeds have the potential to create employment for women and youth in harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easy to understand or access especially by the VMGs • VMGs have low access to seed sources due to their limited mobility • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation

VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar project	To be determined
Application guidelines for users	-
G: 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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., , Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Bayer Crop science

Reference

Louwaars, N.P., van Marrewijk, G.A.M., 1996. Seed supply systems in developing countries. Technical Centre For Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands.

Schulz, S.; Woldegiorgis, G.; Hailemariam, G.; Aliyi, A.; Haar, J. van de; Shiferaw, W. 2013. Sustainable seed potato production in Ethiopia: from farm-saved to quality declared seed. In: Woldegiorgis, G.; Schulz, S.; Berihun, B. (eds.). Seed potato tuber production and dissemination, experiences, challenges and prospects: Proceedings. National Workshop on Seed Potato Tuber Production and Dissemination. Bahir Dar (Ethiopia). 12-14 Mar 2012. (Ethiopia). Ethiopian Institute of

Agricultural Research (EIAR); Amhara Regional Agricultural Research Institute (ARARI); International Potato Center pp. 60-71.

2.2.8 Sprouting technologies

Technology name	Sprouting technologies
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato yields due to planting of unsprouted seed potato tubers
What is it? (TIMP description)	Sprouting techniques refers to any form of manipulation or treatment done to seed potato tubers to induce sprouting, a process that marks the end of dormancy stage. Sprouting techniques may be physical or chemical treatments, with the former being preferred. Physical sprouting technique includes normal storage of tubers in diffused light store (DLS) hence allowing normal conditions to bring about the sprouting naturally. Chemical sprouting techniques include use of synthetic products containing hormones that trigger inhibition of dormancy stage but promotion of vegetative growth stage
Justification	Kenya produces a lot of potatoes every season on acreage of approximately 160,000ha. These growers require high quality seed potato in a ready-to-plant form since most of them do not have DLS's. In addition, due to acute shortage of shangi certified seed potato, other varieties that take long dormancy periods, such as Unica, are not preferred, yet they are high yielding with better quality tubers for processing. Therefore new sprouting techniques will equip potato farmers with options on how to enhance sprouting, hence having the options of adopting other potato varieties for differentiated markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Other research organizations/institutions (universities) • Processors (Deeper Industries ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods) • Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ)

	<ul style="list-style-type: none"> • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g. Mkulima programme, Smart Farmer, seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social platform – twitter, google apps, Facebook
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of positive seed selection • Establishment of FFBS on Positive seed selection
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs
C: Current situation and future scaling up	
Counties where already promotes if any	To be determined
Counties where TIMP will be promoted	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Non-exposure of the end-user to positive seed selection • Acceptability by the national regulatory organization
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – QDS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Favorable policy support
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of reliable markets: domestic and regional market • Enabling policy environment • Farmer willingness to adopt the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-

Gender issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality potato seeds • Women have been having low yields due to poor quality seeds as they have been using recycled seeds • The training materials and strategies might not be favorable to women farmers who might be semi –illiterate • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women might not be aware of the TIMP due to illiteracy and limited mobility due to their busy schedule
Gender related opportunities	<ul style="list-style-type: none"> • Potato seeds have the potential to create employment for women and youth in harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easy to understand or access especially by the VMGs • VMGs have low access to seed sources due to their limited mobility • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar project	To be determined
Application guidelines for users	-

G: 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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., Patrick Pwipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Bayer Crop science

2.2.9 Cut seed potato tubers

Technology name	Cut seed potato tubers
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato yields due to lack of adequate availability of certified seed potato tubers
What is it? (TIMP description)	Cut seed potato technique refers to a process of cutting into two or more pieces of whole seed potato tuber in bid to increase quantity of planting materials for potato farmers. The cut seed potato are cut using a sharp knife sterilized after every cut in order to prevent transmission of diseases from tuber to tuber. The cut tubers are dipped in wood ash then allowed to cure for a period of 7 to 15 days. When the the cut pieces cure, sort the pieces with atleast a sprout is planted. This technique applies to certified seed potato shortage where the tubers are above 55 mm in diameter. Consideration is made so that the cut made does not injure or damage a sprout, while ensuring that every cut piece has a sprout

Justification	Kenya produces a lot of potatoes every season on acreage of approximately 160,000 ha. These growers require high quality seed potato in a ready-to-plant form since most of them do not have DLS's. In addition, due to acute shortage of shangi certified seed potato, to buy seed potato of their preferred varieties in advance and store. Every planting season triggers acute certified seed potato of preferred variety, Shangi. Therefore cut seed potato techniques will avail potato farmer with high quality planting material for the preferred potato varieties
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Other research organizations/institutions (universities) • Processors (Deeper Industries Ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods) • Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g. Mkulima programme, Smart Farmer, seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social platform – twitter, google apps, Facebook
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of positive seed selection • Establishment of FFBS on Positive seed selection
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs
C: Current situation and future scaling up	

Counties where already promotes if any	To be determined
Counties where TIMP will be promoted	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Non-exposure of the end-user to cut seed potato technology • Acceptability by the national regulatory organization
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – QDS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Favorable policy support
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of reliable markets: domestic and regional market • Enabling policy environment • Farmer willingness to adopt the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality potato seeds • Women have been having low yields due to poor quality seeds as they have been using recycled seeds • The training materials and strategies might not be favorable to women farmers who might be semi –illiterate • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women might not be aware of the TIMP due to illiteracy and limited mobility due to their busy schedule • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations • Women and stakeholders might not get improved seeds when needed due to inadequate supply from the seed sources • Pessimism expressed by farmers of new technology and the associated risks
Gender related opportunities	<ul style="list-style-type: none"> • Potato seeds have the potential to create employment for women and youth in harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth

	<ul style="list-style-type: none"> • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easy to understand or access especially by the VMGs • VMGs have low access to seed sources due to their limited mobility • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar project	To be determined
Application guidelines for users	-
G: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Further research
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Judith Oyoo., Patrick Pwapiwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development)

	<ul style="list-style-type: none"> • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Bayer Crop science
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2.2.10 True potato seed (TPS)

Technology name	True potato seed (TPS)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato yields due to non availability on time basis in sufficient quantities of certified seed potato
What is it? (TIMP description)	True Potato seed (TPS)/hybrid is the actual botanical seed produced by sexual reproduction and is formed inside the fruits/berries of potato, resembling tomatoes. True potato seed is occasionally formed after the potato has finished flowering. It is considered an alternative source of high quality seed for potato production. While certified seed potato takes several months to produce, they are bulky and high rate of derioration, TPS/HTPS is lighter to transport, store and handle.
Justification	Kenya produces a lot of potatoes every season on acreage of approximately 160,000 ha. These growers require high quality seed potato in a ready-to-plant form since most of them do not have DLS's. TPS/HTPS does not require DLS to store, light, easy to handle with very low seed rate compared to the bulky certified seed potato which requires 18 bags of 50 kg to cover an acre.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Other research organizations/institutions (universities) • Processors (Deeper Industries ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods) • Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning

	<ul style="list-style-type: none"> • Mass media- e.g. Mkulima programme, Smart Farmer, seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social platform – twitter, google apps, Facebook
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers, extension officers and other stakeholder on handling TPS • Availability of appropriate channel to disseminate TPS technology
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock, Fisheries & Irrigation (MOALDLF & I) • CIP (International Potato Centre) – Collaborative research on potato variety development • 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)- adoption of technologies • GIZ- Nutrition and potato utilization by the communities • NGOs
C: Current situation and future scaling up	
Counties where already promotes if any	Meru, Kiambu
Counties where TIMP will be promoted	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Non-exposure of the end-user to TPS • Acceptability by the national regulatory organization
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – TPS • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Favorable policy support
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Availability of reliable markets: domestic and regional market • Enabling policy environment • Farmer willingness to adopt the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality potato seeds

development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • The training materials and strategies might not be favorable to women farmers who might be semi –illiterate • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations
Gender related opportunities	<ul style="list-style-type: none"> • Potato seeds have the potential to create employment for women and youth in harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Dissemination methods and documents are not always easy to understand or access especially by the VMGs • VMGs have low access to seed sources due to their limited mobility • VMGs have financial constraints so they are not able to purchase quality seeds • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar project	To be determined
Application guidelines for users	-
G: Status of TIMP readiness (1-ready for	Ready for up-scaling

up-scaling; 2-requires validation; 3-requires further research)	
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Susan Otieno., Nancy Ng'ang'a., Miriam Mbiyu., Judith Oyoo., Patrick Pwaipwai, Jackson Kilonzi
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Bayer Crop science

2.3 TIMPS on Food Safety and GAPs

2.3.1 Food Safety Management System (FSMS)

TIMP Name	Food Safety Management System (FSMS) through Hazard Analysis Critical Control Points (HACCP) Plan for Potato 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	Just like another food handling processed, the potato value chain in Kenya entails processes that pose risks and hazards that have a direct bearing on consumer's health. These hazards also have direct economic consequences affecting families, communities and industries existing in the potato value chain in Kenya. Continuous consumption of hazard laden foods ultimately leads to reduced productivity of the active population in the country. Heavy metal accumulations like lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards have been implicated in neurological disorders, cancer and birth defects.
What is it? (TIMP description)	The Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in potatoes is a system of food safety monitoring and control based on the

	<p>systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the potato value chain 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 potato value chain, a wholesome and safe potato supply can therefore be maintained improving on trade and health within and without Kenya borders.</p>
Justification	<p>The only important tool kit to assure food safety in the potato 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 potato value chain process, ranging from production to processing, transportation, retailing and/or direct utilization by the consumer. Through its application, food safety charts in the potato value chain will easily be identified through critical control points. This will set point 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 potato value chain, the proposed FSMS that will be adopted will minimize hazards in every phase of production, harvesting, processing, distribution and consumption making potato 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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Potato value chain actors from farmers, traders, food vendors and consumers.</p>
Approaches used in dissemination	<ul style="list-style-type: none"> • The entire potato value chain will be evaluated by determining contamination hazards in primary production systems and available control methods for; <ul style="list-style-type: none"> Chemical, physical and biological contaminants; Knowledge on production and post-harvest systems; Experience in implementation of ICM and IPM; Experience with principles and practice of HACCP; GAP, GMP and GHP; Knowledge of the target market demands on safety.

	<ul style="list-style-type: none"> • This HACCP information generated and built on seven principles and actions, i.e; <ul style="list-style-type: none"> ○ Conduct of hazard analysis and identification of preventive measures ○ Identification of critical control points (CCPs) ○ Establishment of critical limits for monitoring of each CCP ○ Establishment of corrective action in the event of a deviation from a critical limit ○ Establishment of record keeping ○ Establishment of verification procedures • This will be used by stakeholders to address the hazard problems along the potato value chain in Kenya. • Dissemination of this generated information will be done through; <ul style="list-style-type: none"> ○ The national and county level, common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • For successful promotion of food safety management system through HACCP in the potato value chain; <ul style="list-style-type: none"> ○ An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the potato 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 potato value chain actors for implementation in order to reduce hazards.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Not promoted in any county of Kenya
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • All counties growing and consuming potato in Kenya.

Challenges in development and dissemination	<ul style="list-style-type: none"> Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Funding of dissemination platforms
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> The value chain of potato in Kenya is willing to adopt the HACCP plan if well engaged.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in potato value chain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> In harvesting and processing potato to meet the acceptable national standards, women and youth play a critical role. Capacity building women in home preparation of potato and its byproducts very critical. Capacity building women and youth in the identifications of food safety hazards/risks along potato value chain.
Gender related opportunities	<ul style="list-style-type: none"> Opportunities exist for women and youth in the marketing and the consumption hub of potato and it's by products as an entrepreneurship.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Potatoes are easy to use by many Kenyans. The concern will be if the VMG have resources to purchase the potatoes from the source. Require strategies that target the VMG during scaling up of the value chain. Need to review access and content of information and their channels to VMGs
VMG related opportunities	<ul style="list-style-type: none"> Identification of critical limits to be defined Control measures to be identified Criteria for compliance already clearly defined for adoption
• E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> N/A
Application guidelines for users	<ul style="list-style-type: none"> N/A
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	<ul style="list-style-type: none"> Ready for up scaling
• G: Contacts	
Contacts	<ol style="list-style-type: none"> Director General, KALRO Dr. Godwin Macharia - Centre Director, KALRO Njoro

	3. Dr. Moses Nyongesa – Centre Director, Tigoni
Lead organization and scientists	<ol style="list-style-type: none"> 1. Mr. John N. Ndung'u, FCRI -KALRO Njoro 2. Mr. Athony Nyaga, KALRO PTC 3. Dr. Francis Wayua, KALRO Kakamega 4. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 5. Mrs. Violet Kirigua, KALRO Headquarters 6. Beatrice Wanjiku, KALRO Njoro 7. Judith Oyoo, KALRO Tigoni 8. Dr. Susan Otieno, KALRO Tigoni
Partner organizations	MOALD, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.3.2 Global Good Agricultural Practices (GAP) and standards in potato production

TIMPs name	Global Good Agricultural Practices (GAP) and standards in potato production
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> • Declining food safety • Reduced food quality • Sustainable farming practices • Reduced environmental impact • Worker safety and health • Traceability
What is it? (TIMP description)	<p>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.</p> <p>It is not about a specific crop production but the process through which production takes. The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely.</p>
Justification	Good Agricultural Practice (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture (by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. 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 potato value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support from government particularly the enforcement of KS1758 for fresh produce domestic scope standard and it is currently at the public participation stage.
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MOALD, Private extension providers, CoG and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMP will be up scaled	All counties in Kenya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Most small scale production systems are centered on women and hence it's the gender group that suffers most from the detriments of poor processes; for example improper application of pesticides results in more women suffering from complications in small scale holdings • This means that adaption of GAPs will increase the benefits of good health to the women and those who work more on the farm

Gender related opportunities	Job opportunity for unskilled women and youth due to systematic method of the processes
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Requires a lot of movement on the farm to maintain records and processes verification Unfriendly dissemination methods and documents, illiteracy, poverty, market access problems
VMG related opportunities	There will be enhanced productivity of smaller parcels of land to the advantage of youth who normally have no access to larger parcels.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Park and Gachukia (2021) The role of the local innovation systems for inclusive upgrading in the Global Value chain: The Case of KenyaGAP in the Kenyan Horticultural Sector. The European Journal of Development Research 33: 578–603
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 and KALRO Tigoni; Director General KALRO.
Lead organization and scientists	Nyaga A., Ndung'u, J., Nyongesa, M., Wasilwa, L. and Kirigua, V., Oyoo, J., Otieno S
Partner organizations and their roles	MOALD, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.4 TIMPS on agronomic practices in potato production

2.4.1 Spacing

Technology name	Spacing
Category (i.e. technology, innovation or management practice)	Management practise
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields because of underutilization of land as a result of poor spacing


What is it? (TIMP description)	<p>Spacing is the planting of a specific number of plants per unit area. Spacing is important because it determines plant population and therefore farmers are in a position to project expected yields. Recommended spacing also gives the plant adequate area for root development to absorb nutrients and develop as well as stolon formation, on which tubers are attached. Additionally, proper spacing allows for good air circulation around the plant minimizing the risks of disease infection. Potato requires a spacing of 0.75 m between rows and 0.30 m between plants as is indicated in the figure below</p> <div> </div> <div> </div> <p>Demonstration of spacing in the field Source: Picture courtesy of Judith Oyoo, KALRO</p>
Justification	<p>Potato being a key food security crop with potential for contribution to economic growth, it is necessary that production is optimized to ensure high yields of acceptable quality. Spacing is one of the key areas that affect production and therefore following recommended spacing will ensure high yields are achieved</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Seed producing companies and SMEs • Other research organizations/institutions (universities) • Processors (Deeper Industries ltd; Propac Ltds, Sereni Fries Ltds)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media – “Mkulima programme” • Workshops • Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Available potato innovation platforms • Technical knowledge on potato production • Mandatory inspection and certification for quality control • funding by government to promote production and distribution of seed of selected potato varieties

Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • KALRO to undertake research on current and new spacings • Ministry of Agriculture & Livestock Development • -Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)
C: Current situation and future scaling up	
Counties where already promoted if any	All potato producing Counties
Counties where TIMP will be upscaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack funds to support dissemination • Weak CIG leadership causing conflicts and disintegration of groups • Weak extension –research linkages
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • National and County government support to fortify CIGs to establish as registered seed merchants • Trained and experienced staff/manpower in KEPHIS service provision as private seed inspectors • Capacity building in entrepreneurship and group dynamics • Aggressive awareness creation through field days, fliers, mass media and social platforms
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Partnership is important in technology dissemination • Involvement of farmers alone is not enough to support adoption • Need to involve traders, processors and exporters and other actors in the value chain • National and County government support is very important for the success of a project/technology
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Availability of seed potato market: domestic and regional market</p> <p>Enabling policy environment</p> <p>Farmer willingness and acceptability</p>
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	Estimated output of 200 bags of 50 kg @ KES 1500; total revenue KES 300,000 less costs = KES 180,000
Gender issues and concerns in	<ul style="list-style-type: none"> • Women and youth lack funds to acquire quality seed potato

development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The training materials and strategies might not be favorable to women farmers who might be semi –illiterate • Women also lack access to agricultural information and extension services hindering them from acquiring information on new technologies and innovations
Gender related opportunities	<ul style="list-style-type: none"> • Potato management practises have the potential to create employment for women and youth in high yields experienced through harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed due to their limited mobility • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories	Potato farmers in potato growing Counties
Application guidelines for users	Seed Potato and Production Guidelines http://www.kephis.org › docs › seedpotatobooklet PDF
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783

	E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Moses Nyongesa., Judith Oyoo., Susan Otieno., Nancy Ng'ang'a, Patrick Pwaipwai., Miriam Mbiyu., Jackson Kilonzi
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • NGOs (CARE Kenya): (Farmer Input Promotion) • County governments (CGs) • USAID FtF (United States Agency for International Agriculture-Feed the Future) • NGOs

2.4.2 Hilling/Earthing up


Technology name	Hilling/Earthing up
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low potato yields as a result of not earthing up/hilling
What is it? (TIMP description)	<p>This is a technique of mounding soil around the base of the potato crop. It can be done manually or mechanically. Earthing up promotes stolonization where tubers are formed and attached. It also a climate smart practice which enhances soil moisture conservation as well as protects new tubers from being damaged by potato tuber moth (PTM)</p> 

	<p><i>Demonstration of earthen up potato crop</i></p> <p><i>Source: Photos courtesy of Judith Oyoo, KALRO</i></p>
Justification	High yields are obtainable when improved potato production technologies and management practices such as earthing up are adopted by potato farmers. In addition, earthing up is a climate smart practice which contributes to productivity. High yields obtainable enhances resilience of households to climate change risks through food availability and incomes from sale of surplus
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, processors, extension service providers, Seed producing companies and SMEs, researchers. Other research institutions such as universities
Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD/Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc), workshops, seminars, trainings, promotional materials (posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<p>Availability of potato innovation platforms</p> <p>Strong research -extension service linkages for dissemination</p> <p>Funding by national and/or County governments</p>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development- Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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) • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): Farmer Input Promotion • KEPHIS – inspection services • CBOs, NGOs (technology upscaling, seed potato multiplication) • Processors –potato processing and value addition
C: Current situation and future scaling up	
Counties where already promoted, if any	In all potato growing Counties

Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by Counties
Challenges in dissemination	<ul style="list-style-type: none"> • Limited exposure by the end-user to the technology • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field days, road shows and FFBS for aggressive awareness creation about the variety • Capacity building of all value chain actors including traders and processors
Lessons learned in up- scaling, if any	Use of FFBS is effective in technology dissemination and adoption and involvement of farmers alone is not enough to support adoption, need to all stakeholders in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmer willingness, available and reliable markets • Favorable weather and good storability • Awareness and acceptability of the variety by target communities. • Enabling policy framework such as the Irish Potato Regulations, 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120,000 per acre
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women and youth are exploited by middle men while marketing their products
Genderrelated opportunities	<ul style="list-style-type: none"> • Potato management practises have the potential to create employment for women and youth in high yields experienced through harvesting, sorting, grading, packing and marketing • Short cropping cycle allows production of several crops per year improving food and nutrition for women and youth • Trading in potato seed is profitable since they are usually in high demand every planting season, increasing income for women and youth • There is potential for improved food security and nutrition for women and youths
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed due to their limited mobility

	<ul style="list-style-type: none"> • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Improved income generation from sale of surplus harvest as a result of adopting earthing up/hilling as potato management practice.
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
F: Contacts	
Contacts	<p>Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org</p>
Lead organization and scientists	<p>KALRO-Tigoni,</p> <p>Moses Nyongesa., Judith Oyoo., Susan Otieno., Miriam Mbiyu and Jackson Kilonzi</p>
Partner organizations	<p>Ministry of Agriculture & Livestock Development</p> <p>International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs</p>

2.4.3 Harvesting

Technology 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	Low potato yields as a result of not poor harvesting practices
What is it? (TIMP description)	<p>This is an agronomic practice of lifting mature potatoes from the ground for purposes of utilization by the end-users. This is done when the potato crop has matured and the vines are completely dry. Alternatively, de-haulming can be done two weeks before harvesting when the crop is physiologically mature; the stage when more than 50% of the potato crop is yellowing, followed by harvesting two weeks later. Harvesting can be manual or mechanized.</p>  <p>Harvesting of tubers <i>Source: Photos courtesy of Judith Oyoo, KALRO</i></p>
Justification	High yields are obtainable when potato is lifted from the ground during harvesting. Harvesting is an agronomic practice that ensure high quality of potato tubers are realized when it is timely and appropriately done. High yields contributes to optimal productivity food security hence productivity and reduction in greenhouse gas emissions caused by rotting of tubers
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, processors, extension service providers, Seed producing companies and SMEs, researchers. Other research institutions such as universities
Approaches used in dissemination	Farmer Participatory Evaluation exercises, On-farm demonstration, Field days, Agricultural shows, MOALD /Extension officers, digital platforms (Viazi soko), farmer to farmer peer learning, mass media (e.g Mkulima programme, Seeds of Gold, KTN Smart Farmer tv etc),workshops, seminars, trainings, promotional materials

	(posters/brochures/leaflets/Variety catalogue) and social Media platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of potato innovation platforms • Strong research -extension service linkages for dissemination • Funding by national and/or County governments • Availability of land to set up demonstration plots
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – provision of basic seed potato and technical backstopping • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • FAO (Food and Agricultural Organization)- co-sharing of resources and networking and knowledge management • CIGs (Common Interest Groups)- implementation of management practises at grass root levels • NGOs (Non-governmental organization) • CBOs, NGOs (technology upscaling, seed potato multiplication) • Off-takers and aggregators
C: Current situation and future scaling up	
Counties where already promoted, if any	In all potato growing Counties
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by Counties
Challenges in dissemination	<ul style="list-style-type: none"> • Limited exposure by the end-user to the technology • Weak research- extension- farmer linkage to support dissemination
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination through public forums such as fairs, exhibitions, field days, road shows and FFBS for aggressive awareness creation about the variety • Capacity building of all value chain actors including traders and processors
Lessons learned in up- scaling, if any	<ul style="list-style-type: none"> • Use of FFBS is effective in technology dissemination and adoption and involvement of farmers alone is not enough to support adoption, need to all stakeholders in the value chain
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmer willingness, available and reliable markets • Favorable weather and good storability • Awareness and acceptability of the variety by target communities. • Enabling policy framework such as the Irish Potato Regulations, 2019
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue KES 240,000 less costs of KES 120,000 = KES 120,000
Estimated returns	Estimated output of 160 bags of 50 kg @ KES 1500; total revenue


	KES 240,000 less costs of KES 120,000 = KES 120,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women and youth are not involved in decision making on the varieties to grow • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Women and youth are exploited by middle men while marketing their products
Gender related opportunities	<ul style="list-style-type: none"> • There is employment for women and youth in value addition and processing (fresh cuts, fresh packs, pre-cooked products, fresh crisps, starch extraction) which can accommodate all gender groups equally • Improved production of potatoes attracts men at various nodes of the value chain • For it being early maturing and well adapted to various agro-ecological zones ensures that there are stable supplies to the market • It is easy to cook hence saves fuel for women
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to production resources such as land, knowledge, information, extension training, credit and quality seed due to their limited mobility • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Communication barriers through language or non-availability of an expert in sign language interpretation
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased production of potatoes leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Improved income generation from sale of surplus harvest as a result of adopting earthing up/hilling as potato management practice.
Application guidelines for users	Nyongesa M, Kinyae P, Oyoo J, Ng'ang'a N, Onditi J and Muchui M (2016) Ware Potato Production guidelines. KALRO Information Brochure series
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires	Ready for up-scaling

further research)	
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa., Judith Oyoo., Susan Otieno., Miriam Mbiyu and Jackson Kilonzi
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

2.5 TIMPS on Integrated Soil and Water Management Practices in Potato production

2.5.1 Integrated Manure Management (IMM)

TIMP name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Complementary technology-Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops.

	<p>Manure is obtained from different animals (poultry, cow, goat, horse) on the farm, but it can also be bought from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties all of which are important</p>  <p>for soil quality and crop production. <i>Manure spread in the field</i> <i>Source: Judith. Oyoo KALRO</i></p>
<p>Justification</p>	<p>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 (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity.</p> <p>Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health.</p> <p>The efficient use of manure is enhancing the capacity of the soil to conserve and accumulate soil organic carbon; maintain or improve crop yield by supplying nutrients when required by plants and reduce effects of climate change through sequestration of carbon.</p>
<p>B: Assessment of dissemination and scaling up/out approaches</p>	

Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration • Open and Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media- e.g Mkulima programme, Smart Farmer and Seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social Media platforms • Exchange visits
Critical/essential factors for successful promotion	<p>Training on feeding, management and use of manure</p> <p>Dissemination approach used to reach target farmers</p> <p>Model demonstration plots using root and tuber crops</p>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • County governments, Provide extension services,
C: Current situation and future scaling up	
Counties where already promoted if any	<p>Traditional potato producing counties- Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho</p>

Current extent of reach	Though small scale farmers in the counties apply manures and composts on their farms, they do not optimize on usage.
Counties where TIMP will be promoted	Emerging potato producing counties in mid-altitude AEZ - Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbor pathogens which can cause disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time</p> <p>Using locally available manure/composts saves on purchase of inorganic fertilizer.</p>
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practised

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • It is labour intensive in terms of handling and application (often by broadcasting) hence may disadvantage women due to their other roles • There will be increased labour intensity for women involved in carrying and spreading manure in the farms • Women might not have access and control of manure as livestock which produce manure are controlled by men
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youth in manure transportation and application • Men and youth males might have an opportunity of selling manure and earn income. • Women have employment opportunities in manure application. • Youth can form groups for collecting and selling Manure • Increased production of potatoes leading to improved livelihoods for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The VMGs are also resource poor, hence may not have access adequate manures, e.g. need large livestock herds • IMM is labour intensive in terms of handling and application hence may disadvantage VMGs. • VMGs have low adoption due to limited knowledge • VMGs have high illiteracy, poverty, hence might not have finances to purchase manure as they might not have access to livestock • They have less access to information technology and knowledge on IMM • They have limited access to resources such as credit to buy manure and other equipment used in handling manures
VMG related opportunities	<ul style="list-style-type: none"> • Manure is locally available for those farm households with livestock and can build on household incomes by selling it. • Increased production of potatoes leading to improved livelihoods for VMGs • Improved food security and nutrition for 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 guidelines for users	<ul style="list-style-type: none"> • The guideline focus on the following areas:- • Animal feeds • Livestock housing and manure collection

	<ul style="list-style-type: none"> • Manure storage to preserve nutrient and avoid losses • Manure treatment for ease of transport and application in the field • Timing of application for maximum utilization by the crop • Anaerobic digestion for biogas production • Regular analysis of manure to ascertain the quality • Manure/Composts take a long time to cure, hence need good planning prior to use
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 S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba and Susan Otieno
Partner organizations	County government, Private Public Partnerships, CIGs, CIP

GAPS

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

2.5.2 Integrated Soil Fertility Management (ISFM)

TIMP name	Integrated Soil Fertility Management (ISFM)
Category (i.e. technology, innovation or management practice)	Complementary technology-Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil fertility, low organic matter, restoring soil structure and conserving the limited available moisture in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed 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	<p>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.</p> <p>A large proportion of soils in the NAVCDP 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.</p> <p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities)
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Training in workshops • On-farm visits • Farmer field schools (FFS) • On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • 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 • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.
Partners/stakeholders for scaling up and their roles	<p>County government extension services; Provide link with farmers.</p> <p>Community farmer groups; play coordination role for ease in problem identification and dissemination.</p> <p>CIP (International Potato Centre) – Collaborative research on potato variety development</p>
C: Current situation and future scaling up	
Counties where already promoted if any	Traditional potato producing counties- Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu,

	Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Current extent of reach	Practiced in some value chains in the 10 counties above
Counties where TIMP will be promoted	Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado
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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • ISFM integrates participation of male and female gender roles during field activities. • The activity is labor intensive especially for women since it involves carrying heavy loads to the farms. • It increases workload for women who have multiple roles such as domestic roles • Adoption and scaling up of ISFM technologies could be affected by the ownership of farms as they are mainly owned by men. • Women have less access to training and extension services on the ISFM • Decision making at the farm level on the ISFM is dominated by men • Women and youth have limited access to productive resources such as fertilizers and quality seeds than men due to • Women have less access to agricultural information, technology and knowledge • There is slow information and awareness flow to female farmers due to their low academic levels
Gender related opportunities	<ul style="list-style-type: none"> • Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that saves on cost which is

	<p>good for all gender in the farm household reducing the cost of production of potatoes</p> <ul style="list-style-type: none"> • ISFM will create employment opportunities for youth males employed in transport and in farm activities • Women and youth males have opportunity to sell manures, fertilizers and seed to earn income. • There will be increased production of potatoes hence improving food security and nutrition for households
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Some VMGs are physically disadvantaged to participate in any ISFM related activity. • They are also resource poor and may not have the resources to purchase manures and fertilizers as required for successful implementation of the practice. • VMGs have higher illiteracy, poverty, market access problems • They have less access to information technology and knowledge on ISFM
VMG related opportunities	<ul style="list-style-type: none"> • The technology if well-practiced can increase farm incomes of VMGs by up to 50%. • There is potential of improved production leading to stable supply of potatoes to the markets and livelihoods for 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	<p>Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients.</p> <p>Ensure that good agronomic practices are upheld</p> <p>For sustainability, lone use of inorganic or organic materials should be avoided.</p>
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	2 =Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa
Partner organizations	County government, Private Public Partnerships, CIGs, CIP

Research Gaps

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

Testing (fertilizer types, rates, frequencies) in different varieties and ecological zones

2.5.3 Rapid soil testing services

TIMP name	Rapid soil testing services
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	<p>Conventional methods for soil testing are not cheap to farmers, results take long and are not reproducible.</p> <p>The methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously.</p> <p>Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols.</p> <p>Limited access to soil testing services (centralized soil testing laboratories and cost).</p>
What is it? (TIMP description)	<p>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 SoilCares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.</p>
Justification	<p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) Extension officers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer visits • Training in workshops • Publicity campaigns done at County levels.
Critical/essential factors for successful promotion.	<ul style="list-style-type: none"> • Availability of the necessary equipment for rapid on the spot soil testing. • Established rapport between farmers and the technical personnel involved in soil testing.

	<ul style="list-style-type: none"> • 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, 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	<ul style="list-style-type: none"> • 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 SoilCares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already promoted	Technology has not been promoted though testing has been ongoing in a few counties
Current extent of reach	Minimal reach in Nyeri County
Counties where TIMP will be up scaled	All the NAVCDP Counties
Challenges in dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 upscaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<p>Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation.</p> <p>Shipping selected soil and plant materials for further testing and results verification in a certified lab.</p>
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	<ul style="list-style-type: none"> • The technology may favour youth who are better placed to handle the modern testing equipment. • Decision on soil testing is dominated by men • Women have less access to training and extension services on the Rapid soil testing Technology • Women and youth have limited access to productive resources such as credit to pay for soil testing • Women have less access to agricultural information, technology and knowledge on rapid soil testing technology
Gender related opportunities	<ul style="list-style-type: none"> • Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling • The technology has the potential of increasing production of potatoes and their quality increasing income for the women, men and youth • The TIMP will lead to increased food security for women and the youth
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs have higher illiteracy, poverty, hence they might not be aware of rapid soil testing • VMGs have less access to information technology and knowledge on rapid soil testing • They have limited access to resources such as rapid soil testing kits • VMGs have limited access to productive resources such as land, equipment and might not have funds to pay for the services

VMG related opportunities	<ul style="list-style-type: none"> • Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling • The technology improved production and quality increasing income for the VMGs • The technology has the potential of increasing production of potatoes and their quality increasing income for the VMGs • The TIMP will lead to increased food security for women and the youth
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 (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	C. Kibunja, A. Sila, D. Kamau, A.O. Esilaba
Partner organizations	All the selected County governments Soil Cares,CIP ICRAF and iSDA

GAPS

1. Determination of location-specific soil nutrient status
2. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
3. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
4. Developing a fertilizer recommendation system with options for new blends.
5. Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities per farmer needs.
6. 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.
7. Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country

2.5.4 Bench terraces

TIMP name	Bench terraces
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils, farming on slopes, reduced downstream sedimentation
What is it? (TIMP description)	<p>Bench terraces are a conservation structure which are platform like construction (looking like staircase on slope) constructed along the contour of the sloping land. They 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. Close the terrace by growing grass on the last flat area at the bottom of the terrace.</p> <p>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.</p>  <p><i>Bench terrace</i> <i>Source: Picture courtesy of Wamuongo J, KALRO</i></p>
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	<ul style="list-style-type: none"> • Potato farmers • Agripreneurs • Seed producing companies and SMEs • Other research organizations/institutions (universities) Extension officers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm and on-station demonstrations during farmer field schools


	<ul style="list-style-type: none"> • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers. • Potato Innovation Platforms • Potato Farmer Field and Business Schools • Training workshops, Seminars, Meetings • Field days, Agricultural shows • Farmer research networks • Farmer to farmer • Mass media • Agricultural programs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive research to release and validate potato soil & water management practices • Mechanism for interaction of potato value chain stakeholders • Well organized farmer groups and networks • Good marketing models and path ways • County and central government support • Funding to research, validate and promote new potato technologies • Collaboration between all partners and stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	Traditional potato producing counties- Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Current extent of reach	Practised in some Counties
Counties where TIMP will be promoted	Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Farmers need to be supported with appropriate equipment for preparation of bench terrace for efficiency and increased output per man hour.

	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • 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 <i>Bench terrace</i> preparation. The cost will depend on the land size, labor costs 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	<ul style="list-style-type: none"> • Women have limited access to productive resources such as land, credit facilities, farm equipment hence might not be able to adopt bench terracing • Making decisions on bench terraces may limit women from adopting in some regions where decision making is dominated by men • Women have limited accessibility to agricultural technology and information including on bench terraces • The technology is labor intensive hence may disadvantage women and members who cannot procure labor services due to limited finances • Differing accessibility of information between men and women because of gender norms may limit women from having information on bench terracing • There is slow information and awareness flow to female farmers due to their low academic levels hence might not get the information on bench terracing
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production of potatoes leading to increased food security and nutrition for households • There is potential of increased income for women and youth

VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • The labor cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • VMGs have limited to productive resources such as land, farm equipment and information • Bench terracing is labor intensive limiting the participation of VMGs who might be sick, and others abled differently
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	<p>Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos</p> <p>"Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed It into the river and the crop grew short. But when we made terraces the soil erosion stopped and we got good crops.</p>
Application guidelines for users	<p>Terraces draining in one direction should be at least 100 m 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.</p> <p>Terraces should drain run-off 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%.</p>
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>

Lead organization and scientists	E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension offices, CIP

2.5.5 Fanya Juu Terraces

TIMP name	Fanya Juu Terraces
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	<p>‘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 run-off barrier and the trench (ditch) is used to retain or collect run-off. The embankments are usually stabilized with fodder grasses. Crops, such as bananas, paw paws, citrus and guava, are grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off.</p> <p>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.</p>  <p><i>Fanya juu terrace</i> <i>Source: Picture courtesy of Wamuongo, KALRO</i></p>
Justification	<p>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.</p> <p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers


Approaches to be used in dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	Practiced in many parts of Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru, especillay among households with steep sloppy land
Counties where TIMP will be promoted	Busia, Kisumu, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos, Taita Taveta, Isiolo, Lamu.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • '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

	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The main input cost is the labour for <i>terrace</i> 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	<ul style="list-style-type: none"> • <i>Fanya Juu</i> is laborious for women and it also increases their work load leading to low adoption by women • Women have limited access to productive resources such as land, farm equipment and inputs • Limited decision making power on land use may limit women adopting <i>Fanya Juu</i> • Differing accessibility of the technology and information may disadvantage women • Women have limited finances to hire labor for <i>Fanya Juu</i> due to limited access to credits • Women and youth have limited access to education, training and extension services relating to <i>Fanya Juu</i> • Men dominant most decisions at the household and community levels on agricultural technologies to be applied in potato farms such as <i>Fanya Juu</i> • There is slow information and awareness flow to female farmers due to their low academic levels • <i>Fanya Juu</i> is labor intensive which might affect adoption by women
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender • There will be creation of employment for women and youth at various nodes of the value chain
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited decision making power on land use may limit VMG in adopting <i>fanya juu</i> • VMGs are rarely invited to attend awareness and sensitization campaigns for agricultural technologies such as <i>Fanya juu</i> due to their physical body 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.

	<ul style="list-style-type: none"> The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	<ul style="list-style-type: none"> <i>Fanya juu</i> is labor intensive hence it creates employment for youth <i>Fanya juu</i> 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	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	<ul style="list-style-type: none"> The ‘fanya juu’ trench is 60 cm wide by 60 cm deep, and the bund 50 cm high by 150 cm 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 1. Ready for upscaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension service.

2.5.6 Retention ditches

TIMP name	Retention ditches
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off, drought
What is it? (TIMP description)	<p>Retention ditches are trenches designed to catch and retain incoming run-off 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.</p>  <p><i>Retention ditch</i> <i>Source: Picture courtesy of Wamuongo J, KALRO</i></p>
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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<p>County government extension service providers – delivery of information to farmers, technology access, capacity building</p> <p>Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor.</p> <p>External service providers – capacity building and access to technology</p>
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 minimally in Tharaka Nithi and Makueni
Counties where TIMP will be promoted	Busia, Kisumu, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos, Taita Taveta, Isiolo, Lamu.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender

	<ul style="list-style-type: none"> Youthful male and women will provide labour during the implementation of the technology
VMG issues and concerns in development and dissemination	<p>Limited access to information will limit access to information and adoption</p> <ul style="list-style-type: none"> Limited decision making power 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	Application of contour ridge 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	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 20 m 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 upscaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>

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 service.

2.5.7 Grass strips

TIMP name	Grass strips
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	<p>Grass strips are dense strips of grass planted 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.</p>  <p><i>Grass strips</i> Source: Picture courtesy of E. Mutuma, KALRO</p>
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	<p>Approaches to be used in the dissemination include:</p> <ul style="list-style-type: none"> 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	<p>Availability of labour</p> <p>Availability of land, apart from cropland.</p> <p>Farmers and extension service with skills to design and construct stone lines.</p> <p>Land tenure systems that allows individual ownership</p>
Partners/stakeholders for scaling up and their roles	<p>County government extension service providers – delivery of information to farmers, technology access, capacity building</p> <p>Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor.</p> <p>External service providers – capacity building and access to technology</p>
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 widely in many counties, especially where crop-livestock interactions is key
Counties where TIMP will be promoted	All Counties with suitable environment for potato production
Challenge(s) in development and dissemination	<p>Labour intensive for maintaining and controlling grass from becoming a weed</p> <p>Reduced land area for crop production</p>
Suggestions for addressing the challenges	<p>Farmers need to be supported with appropriate tools and suitable grass varieties.</p> <p>Capacity building on the maintenance of grass strips.</p> <p>Training on site specific designs and layout</p>
Lessons learned, if any	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Enforce policies on soil and water conservation at the County level Create awareness on the importance of soil and water conservation Avail low cost technologies for soil and water conservation
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 depends on the value chain being addressed and also type of grass

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 technology.
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited access to information will limit access to information and adoption • Limited decision making power 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	Application of contour ridge 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	
Application guidelines for users	<p>Spacing between grass strips depends on the slope of the land. It can be 20 - 30 m on gentle slopes and 10-15 m 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 cropped 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.</p>

F: Status of TIMP readiness 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension service.

2.5.8 Intercropping

TIMP name	Intercropping
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Increased farm productivity, declining soil fertility and degradation, soil erosion, weed infestation and vulnerability to pests and diseases
What is it? (TIMP description)	Intercropping is the planting of two or more crops in the same field with potato crop such as maize and potato. Intercropping, also known as inter planting, provides additional income, food, provide shade, fixes nitrogen, and controls weeds and soil erosion. It also provides a lot of biomass to form residues to be returned as organic inputs to the soil in form of mulch and compost. Care should be taken when intercropping potato with other crops because some plants host pests and can transmit diseases to the potato crop. The types of intercropping that can be adopted by potato growers include row intercropping and relay intercropping

	 <p><i>Intercropping of potatoes and maize</i> Source: Picture courtesy of E. Mutuma, KALRO</p>
Justification	<p>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 missing in single-crop environment</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato Farmers and wide range of users
Approaches to be used in dissemination	Demonstrations, Agricultural shows and Extension services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • 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	<p>County governments – to provide extension services, farmer mobilization and policy formulation</p> <p>NGOs – to provide support on capacity building and micro-financing services</p>
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

Current extent of reach	Although farmers in these counties practice intercropping, most fall short of using the right seed and agronomic practices, hence do not benefit from the technology
Counties where TIMP will be up scaled	All the potato Counties
Challenges in dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • The practice integrates participation of both male and female gender roles during field implementation • Potato stakeholders may not be aware of the benefits of intercropping especially women due to their limited access to agricultural information and extension services • Gender disparities in access to information may impact on adoption decisions

	<ul style="list-style-type: none"> • Access to information is a pre-requisite for informed decisions on adoption. • Intercropping makes weeding complicated for women hence increasing their workload • Women have limited access and control to productive resources such as land limiting their decision on what should be planted in the land • Most of the household decisions relating to the management practices to be applied are done by men
Gender related opportunities	<ul style="list-style-type: none"> • 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 • Intercropping leads improved food security and nutrition for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to productive resources such as land, farm equipment, credits • VMGs have limited access to agricultural and extension services so they might not have appropriate information on intercropping • Inter-cropping requires different varieties of seeds and other inputs such as fertilizers VMGs might not be able to buy the required inputs due to lack of finances.
VMG related opportunities	<ul style="list-style-type: none"> • Intercropping offers employment for VMGs • It has a potential of increasing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers have reported improved soil conditions, reduced run-off 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	<ul style="list-style-type: none"> • 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 favours 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

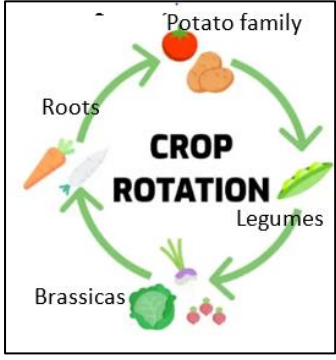
	<ul style="list-style-type: none"> • This is because if plants from two families are mixed in the same bed or field, achieving a substantial time lag before replanting either of those families may be difficult • Intercropping requires extra care and effort in planning and maintaining a viable crop rotation
F: Status of TIMP readiness (1=Ready for up scaling; 2=Requires validation; 3=Requires further research)	3=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 and National governments, CIP National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs (CARE Kenya): (Farmer Input Promotion)

GAPS

1. Major information gaps on intercropping performances in specific areas of Kenya
2. Develop agro-ecological and crop specific intercropping patterns to provide food, feed and fertility enhancement
3. Spatial variation in intercropping patterns
4. Variation in growth patterns and crop durations of intercrops introduced in potato systems

2.5.9 Crop Rotation

TIMP name	Crop Rotation
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	

Problem addressed	Breaking build-up of pests, weeds, diseases and chemicals. Reduces soil erosion in cases of excessive rainfall, depletion of nutrients within one level of soil depth.
What is it? (TIMP description)	<p>Crop rotation is the practice of growing a series of several types of crops in the same crop field in a repetitive sequence defined in order of a year or years of cropping. It is encouraged to resolve soil constraints and maximize utilization of available land.</p> <p>This technology involves selecting appropriate crops for rotation, suitable rotation patterns and calendar.</p> <p>Crop rotation is a climate smart practice that enhances GHG emission through carbon sequestration, cushions farm families against climatic risks and hazards through diverse enterprises that boost household incomes and food diets.</p> <p>Potatoes should be grown on land where potatoes and other Solanaceous crops have not been grown in the previous seasons</p>  <p>Crop rotation diagram</p>
Justification	<p>Rotation will discourage build-up of pests and diseases and depletion of specific nutrients at different soil depths.</p> <p>Rotation of potato will benefit the subsequent crop with nutrient availability</p> <p>The practices considers crops that are important for pest and disease management such as garlic and onion.</p> <p>The space on the farm will be efficiently utilized in properly planned rotation</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, extension staff, processors
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Critical/essential factors for successful promotion	<p>Farmers need to readily adopt intercropping and rotation recommendations</p> <p>Selection of crops for rotation should be professionally done</p>


Partners/stakeholders for scaling up and their roles	NGOs, extension, private service providers
C: Current situation and future scaling up	
Current extent of reach	Mainly in Nyandarua County
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> • The labour intensive nature of the task may discourage farmers from practising it • Scarcity of training materials on compatible rotations • Limited land available for rotation
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Clearly demonstrate the economic advantage of the practice. • Continuous training on the practices • Efficient land use planning
Lessons learned in up scaling, if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Farmers should be educated on the practice • Favourable environmental conditions for diversification and production of the alternative crops. • The national and County governments should support the adoption of diversification by the farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	42,000/- per acre
Estimated returns	380,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as land, credit, and quality seeds than men • Crop rotation is limited by land ownership because some potato stakeholder especially women do not have land and they do not have finances to enable them hire land • Women and youth have limited access to education, training and extension services than men so they might not be aware of the benefits of crop rotation • Most decisions relating to use of farm management practices is made by men
Gender related opportunities	<ul style="list-style-type: none"> • There is increased soil fertility leading to improved production of potatoes • There is increased food security and nutrition for households
VMG issues and concerns in	<ul style="list-style-type: none"> • VMGs have limited access to productive resources such as land, credit, and quality seeds

development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to training and extension services where they could get information on crop rotation • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to new information on new technologies and innovations • There is low adoption by VMGs due lack of awareness of the benefits of crop rotation
VMG related opportunities	<ul style="list-style-type: none"> • Increased production of potatoes due to crop rotation leading to employment for VMGs • There is potential for increased incomes for VMGs due to improved production of potatoes as a result of crop rotation • Increased food and nutrition security for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Laikipia, Meru, Nyeri, Nakuru, Embu and other counties have benefited from growing the crop with improved seeds
Application guidelines for users	Reference Extension materials and handouts
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-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO, Moses Nyongesa, Judith Oyoo Susan Otieno and Miriam Mbiyu
Partner organizations	Ministry of Agriculture & Livestock Development International Potato Centre (CIP) National Potato Council of Kenya (NPCK) International Centre for Insect Physiology and Ecology (ICIPE) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) NGOs (CARE Kenya): (Farmer Input Promotion)

Research Gaps:

Nutrient use efficiency and nutrient budgets from rotation crops

2.5.10 Mulching

TIMP name	Mulching
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in the soil. Suppression of weeds, loss of organic matter, managing salinity in ASALS.
What is it? (TIMP description)	<p>Mulching is the covering of soil between crop rows or around trees with materials, rougher than the surface of the soil to protect it from splash erosion and formation of crust. Different materials are used, including organic mulch (from e.g. grass, straw, hay, bark, leaves, husks sand, sea shells, pine needles, gravel, and stone) and synthetic mulch (plastics etc) Benefits: retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose).</p>  <p><i>Mulching with straw</i> <i>Souce: Judith Oyoo, KALRO</i></p>
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 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	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
Challenges in dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.
Lessons learned	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 low cost but labour intensive during the initial application. Such costs are dependent on value chain and plant spacing
Estimated returns	Dependent on value chain but generally >100% of the initial investments.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The practice uses remnants from previous crops/plants that may offer competition in terms of fuel wood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuel wood and men for livestock feed • This will negatively affect the adoption and scaling up. • Women and youth have limited access to productive resources such as farm crop residues • Women and youth have limited access to education, training and extension services on mulching in potato farms • Women have less access to agricultural information, technology and knowledge on mulching • Men dominant most decisions at the household and community levels especially on the management practices to be applied in their farms • Mulching may increase labour burden for women involved in collection and carrying the crop residues to the farm

Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere Similarly, the improved productivity will benefit both gender in terms of higher earnings
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Though easy to use, it is be a bit labour intensive for VMGs • VMGs have higher illiteracy, poverty, market access problems • VMGs have less access to information technology and extension services hence they might not have adequate information on mulching • VMGs are poor hence they do not have finances to pay for hired labor
VMG related opportunities	<ul style="list-style-type: none"> • Mulching reduces labor of potato production for VMGs • There is improved production of potatoes leading to increased income for VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers in Laikipia Meru, Nyeri, Nakuru Embu and other counties have benefited from growing the crop with improved seeds
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 compacted mulch prevents oxygen from passing through and can starve your crop roots. Mulch should be replenished once a year.
F: Status of TIMP readiness (1=Ready for up scaling; 2=Requires validation; 3=Requires further research)	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO, Moses Nyongesa, Judith Oyoo Susan Otieno and Miriam Mbiyu,
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development • International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)


	<ul style="list-style-type: none"> • NGOs (CARE Kenya): (Farmer Input Promotion)
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Gaps:

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

2.5.11 Use of drip irrigation in potato production


TIMP name	Use of drip irrigation in Potato production
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	<p>With increasing effects of climate change, there are increasing incidences of unpredictable weather and erratic rainfall patterns. Crops under rain fed production systems are likely to suffer from effects of drought and insufficient amounts of rainfall during the cropping seasons.</p> <p>Low productivity due to water scarcity</p>
What is it? (TIMP description)	<p>It is a type of micro-irrigation system that allows for optimal usage of limited water resource by controlled delivery of the water to the plant root zone at low pressure using drip lines and emitters to minimize water loss. The layout is above surface and is easy to design and operate. It can be used to apply fertilizer efficiently through fertigation. It Provides an opportunity for farmers to increase crop yields. Use of drip irrigation has been reported to save up to 70% of water used by garden peas in rain fed systems. This technology combines well with the use of row planting and optimum spacing.</p> <p>Drip lines with optimized spacing are laid along the potato rows at planting.</p> <p>Optimum amount of water is supplied to the plant during the critical stages of flowering and pod filling to maximize yields. Drip irrigation is suitable for small holder farms.</p>

	 <p><i>Potatoes planted under drip irrigation</i> <i>Souce: Judith Oyoo, KALRO</i></p>
Justification	<p>Kenya is generally a water-deficient country yet almost all crop production is rain fed. The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Drip irrigation offers an opportunity to produce food with limited water. Main streaming drip irrigation systems into crop production therefore provides an opportunity for farmers to enhance crop resilience, increase yields and incomes. Increased water saving means more water are available for other competing needs (domestic, livestock or industrial)</p> <p>To achieve the desired high yields, the crop needs to receive optimum amounts of water at the rightful time of its growth cycle.</p> <p>In potato, soil moisture deficit reduces growth, interferes with flowering, hampers tuberization resulting in low yield and quality of tubers</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, extension staff, processors, farmers
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training manuals
Most effective approach	On-farm experimentation, larger plot effect demonstrations and exchange visits,FFBS, Training manuals, brochures, leaflets, fact sheets
Critical/essential factors for successful promotion	Favourable conditions for drip irrigation especially water supply Source of capital for initial investment
Partners/stakeholders for scaling up and their roles	Extension service providers (private and public and County government- Trainers of Trainers, Agripreneurs Private sector- supply of equipment - NGOs (Kenya Red Cross, Action Aid, World Vision, OXFAM etc.) – Offer extension services, Train trainers

	KALRO - Technical backstopping
C: Current situation and future scaling up	
Current extent of reach	Mainly in Nyandarua County
Counties where already promoted, if any	None
Counties where TIMP will be up- scaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> • Scarcity of capital for initial investment in drip irrigation • Conflict over water resource has been reported • Limited know-how among farmers
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Linking farmers to financial and other credit institutions • Collective approach to investment through farmer groups • Continuous training of farmers • To encourage formation of water users association to reduce conflicts
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Drip system increases yield, incomes and food security. • Linking farmers to markets is critical for enhancing sustainability. • Soil mulching (crop residue or green manures) in a drip systems help preserve moisture and add nutrients to the soil • Linking farmers to financial institutions enables them to purchase systems
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Harmony in communal utilization of water should be cultivated • All forms of water harvesting should be encouraged • Sustainable supply of water for irrigation • Policy on rational distribution of available water should be observed.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES 100,000
Estimated returns	<ul style="list-style-type: none"> • Income from drip system rises by as much as 35% stemming from the management of crop water stresses • Increased water saving means more water is available for other competing needs (domestic, livestock or industrial)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Drip systems are easily installed and therefore suitable for all genders • Drip systems tend to reduce workload for all gender and provide significant positive impact on family food and nutritional intake • Drip irrigation is acceptable and easy to adopt and upscale by both male and female, including the youth • Women and youth have financial constraints due to limited access to credit hence they are not able to purchase the drip kit.

	<ul style="list-style-type: none"> • Women and youth have limited access to education, training and extension services hence they might not have adequate knowledge on drip irrigation usage especially in potato farms • Women have less access to agricultural information, technology and knowledge on drip irrigation • Men dominant most decisions at the household and community levels including the use of drip irrigation
Gender related opportunities	<p>Opportunities available for women and men to generate sustainable income</p> <p>There is the potential of having improved food security</p>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs might not have finances to purchase drip kits due to limited access to credit facilities • VMGs have limited access to agricultural information and extension services so they might not have appropriate information relating to drip irrigation system and its benefits
VMG related opportunities	<ul style="list-style-type: none"> • Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables • There is potential of increased food security for VMGs
E: Case studies/profiles of success stories	
Success stories	<p>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.</p>
Application guidelines for users	<p>Never bury emitters underground unless they are made to be buried</p> <p>Don't bury drip tube, moles or other rodents will chew it</p>
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	1 Ready for up scaling
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO; Isaya Sijali
Partner organizations	<p>AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirliff, and many Micro finance institutions (MFIs), MOALD</p> <p>CIP, NPCK, ICIPE, FAO, CIGs, GIZ</p>

2.5.12 Zeba

TIMP name	Zeba
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Drought that causes crop failure leading to food loss making vulnerable communities exposed to high risks of climate change and to suffer from food insecurity, particularly the women and the children. Rainfall variation and inadequate due to climate change
What is it? (TIMP description)	<p>Zeba is a soil enhancer that absorbs and releases moisture and nutrients only when plants need them, conserving water at a time when food producers are grappling with water shortage occasioned by changing weather patterns.</p>  <p><i>Photograph of Zeba</i> <i>Source: Isaya Sijali, KALRO</i></p>
Justification	<p>The water retention technology is based on a starch based absorbent which comes in form of granules. Each granule has ability to expand by 400 times its original size, trapping water and nutrients which are then released during dry spells while remaining effective for more than an year. Up to 95 per cent of the water held by the granules is released back to the soil. Zeba is also a climate smart technology</p> <p>It also prevents water-soluble nutrients such as nitrogen and phosphorus from being leached out of the rooting zone of tubers</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Ware Potato growers • SMEs • Other research organizations/institutions (universities) • County extension officers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Participatory Evaluation exercises • On-farm demonstration

	<ul style="list-style-type: none"> • Field days • Agricultural shows • MOALD/Extension officers • Partners (CIP, NPCK, FAO, ICIPE, GIZ) • Mobile phone text initiative • Farmer to farmer peer learning • Mass media – e.g. Mkulima programme, Smart Farmer, Seeds of Gold • Workshops, Seminars, Meetings, trainings • Promotional materials (posters/brochures/leaflets) • Social Media platforms
Most effective approach	<ul style="list-style-type: none"> • On-farm trials/demonstrations • Farmer field days
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Recruitment and support for SMEs for potato production • Field demonstrations
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization)- CARE Kenya: Farmer Input Promotion
C: Current situation and future scaling up	
Counties where already promoted if any	Nairobi
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information about the existence of the technology • The only drawback he can see is, ironically, moisture in the air • It's not easy to apply when damp or humid because it turns from a sawdust-like granule to a gel in minutes • It overcame blockages in the trial by flushing graphite powder down the tubes of the applicator before adding the product.
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination - GAPs • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption

	<ul style="list-style-type: none"> • Partnership is important in technology dissemination
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmentally friendly resilient and climate smart. • There is availability of market • The product can be applied with all standard granular application equipment • It is non-toxic, neutral pH and biodegradable • Within 12-18 months, Zeba is consumed by micro-organisms in the soil
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost is KES 1,500 per Kg. (KES 7,500 for 5 Kg/ acre)
Estimated returns	Expected increased production by 1/3 Returns KES 46,200 less cost KES 7,500= KES 38,700
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men and therefore women are not involved in decision making relating to new agricultural technologies Zeba • Most of the potato stakeholders especially women might not be aware of Zeba its operation and benefits • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Potato production is done by youth and women but marketing is done by the men so the money goes to men
Gender related opportunities	<ul style="list-style-type: none"> • Adoption of Zeba will increase potato production creating employment for women and youth at various nodes of the value chain • The technology will enhance production of potatoes throughout the year offering stable livelihoods for women and youth • The TIMP if adopted has the potential of increasing food security and nutrition for households
VMG issues and concerns in development, dissemination and adoption and scaling up	<ul style="list-style-type: none"> • VMGs might not be aware of Zeba as a management practice • They have less access to information technology and knowledge. • They have limited access to finances to purchase the materials required for Zeba implementation • They have limited access to training and extension services on use of Zeba management practice
VMG related opportunities	<ul style="list-style-type: none"> • Adoption of Zeba will increase potato production creating employment for VMGs at various nodes of the value chain • The technology will enhance production of potatoes throughout the year offering stable livelihoods for VMGs • The TIMP if adopted has the potential of increasing food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-

Application guidelines for users	* Take 5 kg of Zeba per acre and mix thoroughly with the recommended fertilizer
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	3-Requires further research
G: Contacts	
Contacts	NPCK
Lead organization and scientists	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Partner organizations	Ministry of Agriculture & Livestock Development National Potato Council of Kenya (NPCK) FAO (Food and Agriculture Organization) Common Interest Groups (CIGs) Deutsche Gesellschaft für Internationale Zusammenarbeit GIZ) USAID FtF (United States Agency for International Agriculture- Feed the Future) County governments USAID Ftf (United States Agency for International Development- Feed the Future)

Research gaps:

Functionality under varied agro-ecological zones
Performance on subsequent crop after potato production
Effect on yield under varied environmental conditions
After effect on soil quality

2.6 Potato Crop Health TIMPS

2.6.1 Integrated Management of Potato Cyst Nematode

Technology name	Integrated Management of Potato Cyst Nematode (PCN) (<i>Globodera</i> sp)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the Technology, Innovation or Management Practice	
Problem to be addressed	Over 80% yield loss due to potato cyst nematode (PCN) infestation.



Mature females (cysts) attached to roots of potato plant

Source: KEPHIS, Eunice Ringera



Patches of poorly growing/wilting plants on affected potato field

Source: KEPHIS, Eunice Ringera



Healthy and PCN affected potato crop

Source: Ulrich Zunke; Bugwood.org

What is it? (TIMP description)

Integrated management of potato cyst nematodes consists of several approaches applied in an integrated manner to break the cycle of the nematode.

Management strategy

The following management options are recommended:

Cultural practices:

- Always analyse the soil for presence of nematodes in an accredited plant pathology laboratory
- Use clean potato seed to plant

	<ul style="list-style-type: none"> • Apply heavy organic mulch using maize stover to reduce nematode population in soil • Practice crop rotation using non solanaceae crops such as maize, beans, cabbage, carrots, wheat and peas for 7years • Uproot volunteer plants such as potato, tomato and black night shade • Avoid planting spinach, capsicum and eggplant since they are potential alternative hosts for cyst nematodes. • Uproot infected plants and destroy by deeply burying into the soil (approximately 1m) • Avoid movement of infected soils from affected areas or through farm tool • Disinfect farm tools using 40% Kerol • Control run off water and direct it away from fields as this could spread PCN from infested to non-infested areas • Solarise soil using polythene paper of gauge 150 before planting • Plough kale, cabbage, Indian mustard to decompose into the soil for a month before planting • Plant black night shade as a trap crop for 5-6 weeks which is a partial host that allow nematodes to infest but not to mature then destroy the crop by uprooting and burning or burying in deep pits. <p>Bio-control options: Apply green Tithonia or Mexican marigold (Tagetes spp.) organic amendments Drench the plants using Azadirachtin (Achook, Neem cake, Nematon, Nemarock, Neemraj or Nimbecidine at the rate of 600 ml/20l)</p> <p>Chemical management: Fumigate with Velum according to the manufacturers recommendation.</p>
Justification	Integrated management of PCN involves the combined application of cultural and biological practices to control the pest, as well as chemical management practices. Given the high yield losses of 80% caused by PCN and the limited efficacy of conventional approaches in dealing with the pest, integrated management practices need to be practiced for enhanced food security and safety for the environment, producers and consumers.
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, Agripreneurs

Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on nematodes by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage nematodes • Reliable production, storage and distribution of certified seed potato at farm level • Mapping of PCN free zones for up and out scaling of certified seed potato production
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Policy formulation, Capacity building and support public and private extension • CIP (International Potato Centre) - Collaborative research on potato variety development • 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) - backstopping the technologies at grass root levels • GIZ - Nutrition and potato utilization by the communities • Non Governmental Organizations (NGOs) e.g. CARE Kenya - Farmer Input Promotion • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in nematode management • PCPB to promote registration of nematicides for nematodes 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	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia and Kericho</p> <p>Emerging potato producing counties in mid-altitude AEZ - Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado and Nairobi</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Limited information on PCN and its management strategies among farmers • Difficulty for farmers to practice and adopt IPM technologies due to cost and technical capacity • Inadequate knowledge on IPM strategies
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on PCN integrated management strategies • Scaling up participation of end-user in on-farm activities/ adaptive research/ extension activities • Training of stakeholders in IPM options • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS for effective in technology dissemination and adoption • Sensitization is necessary for people to appreciate the use of IPM in nematode 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 upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt the nematodes management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 50,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 80%. Net return per acre KES. 240,000-192,000 = KES 48,000


Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exist in spraying the crop against PCN • VMG groups to produce and multiply quality/certified planting material
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Opportunities for the unemployed exist in spraying the crop against PCN
E: Case studies/profiles of success stories	
Success stories	<p>KALRO Tigoni in collaboration with ICIPE and Bayer Crop Science are carrying proof of concept research trials on integrated practices of PCN management. ICIPE are evaluating different African indigenous vegetables in the ‘dead-end trap technology’. The vegetables are of <i>Solanacea</i> family so that they encourage growth of the nematodes in their life cycle since they are hosts. Preliminary results show that some varieties of black shade attract the juveniles into the roots, then uprooting is done before the juveniles complete their life cycle. This reduces the population of PCN in the soils. In addition, vegetables are harvested hence utilized in households promoting nutritional benefits of vegetable consumption.</p>
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya. 2018. Ochilo, W. N., Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009. • https://infonet-biovision.org/PlantHealth/MinorPests/Potato-cyst-nematode • https://npck.org/spread-and-management-of-potato-cysts-nematodes-pcn-in-kenya/
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	<ol style="list-style-type: none"> 1. Ready for up-scaling
G: Contacts	

Contacts	<p>Centre Director – Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO, Nyongesa M., Mbiyu M., Oyoo J., Otipa M., Amata R., Ndubi, J., MMUST, ² Ogemah, V. Otieno S., Kilonzi J CABI: Duncan Chacha</p>
Partner organizations	<p>CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County Governments, CIGs, Bayer Crop science</p>

GAPS

1. Capacity building on Potato Cyst Nematode identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato cyst nematodes
3. Determine the effects of potato cyst nematodes on yield, quality and implication on economic returns for the farmer

2.6.2 Integrated Management of Potato Tuber Moth

Technology name	Integrated Management of Potato Tuber Moth (<i>Phthorimaea operculella</i>)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Up to 60% yield loss is experienced by potato farmers due to damage by tuber moth.</p>  <p><i>Potato tuber moth damage</i> Source: KALRO, Judy Oyoo</p>
What is it? (TIMP description)	<p>Timely application of management options for this pest during fruit formation is required. The following options can be applied:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Collect and destroy all infested plants. Chop infested tubers finely or bury them deeply (about 50 cm deep). • Avoid movement of tubers from areas known to have tuber moths to areas free of the pest. • Place sticky traps in the farm before the plants start flowering to help reducing migration of female adult moths which lay eggs <p>Biological options Spray with <i>Bacillus thuringiensis</i> at 5-20 grams per 20 litres of water</p> <p>Chemical management Spray with Malathion based products e.g Marathon 50EC and Malaton 50EC at 40-50 ml in 20 litres of water or Deltamethrin based products such as Farm-X, Atom 2.5EC, and Decis 2.5EC at 10-15 ml in 20 litres of water or Bifenthrin based products e.g Biferan 25EC, Seizer 80SC, Talstar at 20ml in 20 litres of water</p>

Justification	<p>Potato production presents an opportunity for food security, nutrition and economic empowerment of producing communities.</p> <p>The timely application of preventive measures to control/ management would lead to higher yields. Potato tuber moth can cause up to 60% yield loss and hence timely application of the control measures is critical to save yields. Farmers/producers will gain healthier and higher tuber yield for economic benefits.</p>
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, Agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on nematodes by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage nematodes • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Policy formulation, Capacity building and support public and private extension • CIP (International Potato Centre) - Collaborative research on potato variety development • 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

	<ul style="list-style-type: none"> • CIGs (Common Interest Groups) - back stopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • 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 potato tuber moth management • PCPB to promote registration of pesticides for potato tuber moth 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	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia and Kericho.</p> <p>Emerging potato producing counties in mid-altitude AEZ (Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado and Nairobi.</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Limited information on potato tuber moth and its management strategies among farmers • Difficulty for farmers to practice and adopt IPM technologies due to cost and technical capacity • In adequate knowledge on IPM strategies
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on potato tuber moth integrated management strategies • Scaling up participation of end-user in on-farm activities/ adaptive research/ extension activities • Training of stakeholders in IPM options
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS for effective in technology dissemination and adoption • Sensitization is necessary for stakeholders to appreciate the use of IPM in potato tuber moth 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 upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt the potato tuber moth management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 45,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 60%. Net return KES 240,000 - 144,000 = KES 96,000
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information and technology • Women are sometimes involved in spraying which may be unhealthy for them
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop against potato tuber moth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop against potato tuber moth
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • https://infonet-biovision.org/PlantHealth/MinorPests/Potato-tuber-moth • https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1. Ready for up-scaling
G: Contacts	
Contacts	Centre Director - Food Crops KALRO Kabete,

	<p>Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Mbiyu M., Oyoo J., Pwaipwai P., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: ² Ogemah, V. CABI: Duncan Chacha</p>
Partner organizations	<p>CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County Governments, CIGs, Bayer Crop science</p>

GAPS

1. Capacity building on Potato tuber moth identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato tuber moth
3. Determine the effects of potato tuber moth on yield, quality and implication on economic returns for the farmer

2.6.3 Integrated Management of Aphids

Technology Name	Integrated Management of Aphids (<i>Macrosiphum euphorbiae</i>) in Potato
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Aphids cause up to 10-30% yield loss of potato</p>  <p><i>Aphids feeding on potato leaf</i> Source: Bayer East Africa</p>
What is it? (TIMP description)	<p>Integrated management of potato aphids involves selection of effective environmentally safe options such as:</p> <p>Cultural practices</p>

	<ul style="list-style-type: none"> • Intercrop potato with repellant crops such as onions and garlic • Propagating seed potato under insect protected environment such as greenhouse or under Agronets • Weed the field to get rid of alternate host for aphids • Maintain a hedge around the potato 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 potato canopy • Use blue sticky traps at the rate of 8 traps per acre <p>Biological options</p> <ul style="list-style-type: none"> • 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 <p>Chemical management 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</p>
Justification	<p>Potato aphid species have increased across the country preventing potential yield of potato in most areas. The use of different insecticide molecules, both of biological and soft-chemical natures have reduced reappearance 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. Planting wild flower strips in the potato fields and hedge rows, will increase the population of beneficial insects.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers, Agripreeurs</p>
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS)

	<ul style="list-style-type: none"> • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /Extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on aphids by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage aphids • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Policy formulation, Capacity building and support public and private extension • CIP (International Potato Centre) - Collaborative research on potato variety development • 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) - backstopping the adoption of technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • Farmers/CBO: participate in trainings and adoption of the technology • KALRO - continually undertake research in aphid management • PCPB - promote registration of pesticides for aphid management • Universities - develop technologies and conduct ToTs • Financial institutions - provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho.</p> <p>Emerging potato producing counties in mid-altitude AEZ (Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado and Nairobi.</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate information on aphid management strategies among farmers

	<ul style="list-style-type: none"> • Low levels of participation of end-user in on-farm activities/ adaptive research/ extension activities • Limited training of stakeholders in IPM options
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Increased information dissemination on aphid integrated management strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Training of stakeholders in IPM options • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS is effective in technology dissemination and adoption • Sensitization is necessary for stakeholders to appreciate the use of IPM in aphid management • Adoption of good agricultural practices by farmers is key in management of the insects • There is increased technology dissemination and upscaling when value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended aphid management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 46,000
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 30%. Net return KES 240,000 - 72,000 = KES 168,000
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge • Women are sometimes involved in spraying which may be unhealthy for them
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop against potato aphids
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for the unemployed exist in spraying the crop against potato aphids.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • https://infonet-biovision.org/PlantHealth/MinorPests/Aphids-8 • https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST, Ogemah, V. CABI: Duncan Chacha
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on aphid identification and management
2. Validation of biopesticides and synthetic pesticides in the management of aphids
3. Determine the effects of aphids on yield, quality and implication on economic returns for the farmer

2.6.4 Integrated Management of Mealybugs of Potatoes

TIMP name	Integrated Management of Mealybugs of Potatoes (<i>Pseudococcus longispinus</i>) Source: blog.growingwithscience.com
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	<p>Yield losses of 60% on potato production</p>  <p><i>Mealybugs, (Pseudococcus longispinus)</i> <i>Source: Roberta, Growing with Science</i></p>
What is it? (TIMP description)	<p>Integrated management of mealybugs includes the use of various pest control strategies. They include cultural, biological and chemical control:</p> <p>Cultural practises</p> <ul style="list-style-type: none"> • Prune and destroy infested plants • Avoid over irrigation/fertilization of potato plants for mealybugs are attracted to plants with high nitrogen levels and soft growth • Spray the affected plant part with a mild solution of water with dish washing detergent at rate of 1 tea spoonful of detergent in 1 litre of water • Disinfect farm tools between plants and farms (Use 50 ml JIK in 1 litre of water), to prevent spread of the insect • Avoid the use of infested plant materials. Before planting, tubers can be treated by immersing them in heated water (mix equal volumes of boiling and cold water) for 5 to 10 minutes to kill the pest <p>Biological options Spray neem formulation (Azadiractin, 1500 ppm) @ 5 ml/l or one lit/acre or 5%, Neem seed kernal extract (NSKE) on a weekly basis to avoid further infestation.</p> <p>Chemical management</p> <ul style="list-style-type: none"> • Apply Acephate 75% Sp @ 1gm/litre of water (e.g. Sinophate at 20g/20L of wate, Asataf at a dosage of 10g/20L) 75% SP

	<ul style="list-style-type: none"> • Apply Buprofezin 400g/L @ 30-60 ml/100L of water (e.g. Applaud SC 40% at a rate of 6 mL / 20 L water) • Spray Segatron at 50ml /20Litres of water
Justification	Mealybugs cause leaf yellowing and curling. The plant weakens causing yield loss of up to 60%. Total crop failure is experienced under high infestation leading to food insecurity. Currently potato farmers use a lot of synthetic pesticides in their control. The integrated pest management practices for potato mealy bugs significantly reduces loss of yields due to damage by this pest. It is a major challenge to potato farmers. The use of IPM methods are environmentally beneficial and generally risk-free for potato 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), Agripreneurs, research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on insects by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension agents - mobilization/sensitization of farmers and extension of the technology • Farmers/CBO- participate in trainings and adoption of the technology • KALRO - continually undertake research in insect management • PCPB - promote registration of insecticides for insect management

	<ul style="list-style-type: none"> • Universities - develop the technologies and conduct ToTs • Farmers/farmer groups - adopt the technologies • National and County Governments - development of enabling policies and create awareness • CGIAR/NGOs - 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	Muranga, Embu. Meru, Nyandarua, Kiambu, Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMPs will be up scaled	Taita Taveta, Laikipia, Wajir, Busia, Siaya, Kisumu, Baringo, West pokot, Kericho.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate information on insect pests infesting potato and losses attributed to them • Low levels of participation of end-user in on-farm activities/ adaptive research/ extension activities • Poor linkages among stakeholders in potato value chain that would enhance information sharing
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Training farmers when to apply the intercropping crop types and promotion of conservation of biological agents to suppress pests • Establish potato innovation platforms for information sharing • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 45,000
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 60%. Net return KES 240,000 - 144,000 = KES 96,000
Gender issues and concerns in development,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals


dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge • Women are sometimes involved in spraying which may be unhealthy for them
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop against mealybugs of potatoes
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop against mealybugs of potatoes
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • Infonet.biovision.org • Gupta, S., and Dikshit, A. K. (2010). Biopesticides: An ecofriendly approach for pest control. Journal of Biopesticides, 3 (Special Issue), 186.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST, Ogemah, V. CABI: Duncan Chacha</p>

Partner organizations	CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments
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GAPS:

1. Explore bio-control options for controlling the potato mealy bugs to minimize on pesticide use

2.6.5 Integrated Management of White Flies

TIMP Name	Integrated Management of White Flies (<i>Bemisia tabaci</i>) in Potatoes
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Yield loss of 40-70% due to white flies infestation in potato production.</p>  <p><i>White flies (Bemisia tabaci)</i> Source: planetbirds.blogspot.com</p>
What is it? (TIMP description)	<p>Integrated management of white flies in potatoes comprises the use of cultural, chemical and mechanical approaches. These includes:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Scout on a weekly basis by inspect adults and eggs on young leaves, and watch out for whiteflies flying when the crop is disturbed • Intercrop potato plants with crops from non solanaceae family i.e. coriander • Plant potato early at the beginning of the season to avoid the time when whiteflies are more likely to occur • Plant certified potato cultivars tolerant to white flies

	<ul style="list-style-type: none"> • Place yellow sticky boards/cards 1 to 4 per 300 square metre field which should be replaced on a weekly basis • Place yellow plastic drinking cups coated with adhesives and stapled on stakes above plant canopies to trap flies • Provide mulch on the potato plants to prevent physical contact of the white flies and with the potato plants • Spray potato plants with soapy water at the rate of 1 table spoon / 4 litters of water late in the evening or early in the morning • Make home made sticky traps by spreading petroleum jelly or used motor oil on yellow painted plywood, 6 cm x 15 cm in size, and position the traps 60-70 cm above the plants <p>Biological options Conserve natural enemies i.e. parasitic wasps in the ecosystems through application of environmental friendly synthetic insecticides i.e. neem formulation (Azadiractin, 1500 ppm) @ 5 ml/l or one lit/acre or 5%, Neem seed kernal extract (NSKE).</p>
Justification	White fly, is the major constraint in potato production. It can lead to yield loss of between 40 and 70%. The integrated pest management practices for white fly sustainably reduces yield loss caused by this pest hence will enhance food security. The application of this practices is also environmentally friendly and relatively safe to farmers and consumers of potato.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), Agripreneurs, Research organizations and universities, as well as CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Awareness creation on the benefits of the IPM management practices • Create a platform for interaction of potato value chain stakeholders • Adoption of appropriate agronomic practices by farmers

	<ul style="list-style-type: none"> • Form well organized farmer groups and networks to enhance information flow • 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	<ul style="list-style-type: none"> • Public and private extension agents - Mobilization/ sensitization of farmers and extension of the technology • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in insect management • PCPB - promote registration of insecticides for insect management • Universities - develop the technologies and conduct ToTs • Farmers/farmer groups - adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs - link farmers to the market and lobby for changes in agriculture policies to favour the farmer • Financial institutions - provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Muranga, Embu, Meru, Nyandarua, Kiambu, Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMP will be up scaled	Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Increased information dissemination on IPM strategies for insects • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Dissemination of IPM practices and safe use of pesticides • Establish potato innovation platforms for technology dissemination
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in disease management • Adoption of good agricultural practices by farmers is key in management of the diseases • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform

	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 disease management practices Producers are organized in groups to ensure that management practices are effectively up-scaled Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 33,000
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 70%. Net return KES 240,000-168,000 = KES 72,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals Women have limited access to education, training and extension services Women have less access to agricultural information, technology and knowledge Women are sometimes involved in spraying which may be unhealthy for them
Gender related opportunities	Opportunities for youths exists in spraying the crop against white flies.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals 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 for the unemployed exist in spraying the crop against white flies.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	<ul style="list-style-type: none"> Legg, J., Gerling, D., Neuenschwander, P. (2003). Biological Control of Whiteflies in Sub-Saharan Africa. In Biological Control in IPM System in Africa. CAB International. ISBN: 0-85199-639-6


	<ul style="list-style-type: none"> • Tropical Whitefly IPM Project: Book 'Whitefly and Whitefly-Borne Viruses in the Tropics: Building a Knowledge Base for Global Action'. www.researchgate.net • United States Department of Agriculture, Whitefly Knowledgebase: www.entnemdept.ufl.edu • CABI. (2005). Crop Protection Compendium, 2005 Edition. CAB International Publishing. Wallingford, UK. www.cabi.org • Infonet.biovision.org
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1-Ready for up scaling
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Otipa M., Oyoo J., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST, Ogemah, V. CABI: Duncan Chacha</p>
Partner organizations	MoAD, CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

GAPS

1. Capacity building on White flies identification and management
2. Validation of bio-pesticides and synthetic pesticides in the management of White flies

2.6.6 Integrated Management of Spider Mites

TIMP Name	Integrated Management of Spider Mites (<i>Tetranychus urticae</i>) of Potatoes
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Spider mites cause yield loss of up to 42% on potato production.</p>  <p><i>Spider mites (Tetranychus urticae)</i> Source; plantwise.org</p>
What is it? (TIMP description)	<p>Integrated management of the spider mites includes the use of various pest control strategies. These are:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Site nurseries away from infested crops and avoid planting next to infested fields • Grow healthy crops; avoid water and nutrient stress • Apply mulch and incorporate organic matter into the soil to improve the water holding capacity and reduce evaporation • Keep perennial hedges such as pigeon peas, to encourage predatory mites, which predate on spider mites • Uproot and burn infested plants. This can be successful during the early stages of infestation when the mites concentrate on a few plants • Keep the field free of weeds • Remove and burry infested crop residues immediately after harvest • Spray potato plants with soapy water at the rate of 1 table spoon / 4 litters of water late in the evening or early in the morning • Use sticky pheromone traps • Practice overhead irrigation to knock off the red spider mites colonies <p>Biological options</p> <p>Conserve natural enemies' i.e. parasitic wasps in the ecosystems through application of environmental friendly synthetic insecticides i.e. neem formulation (Azadiractin, 1500 ppm) @ 5 ml/l or one lit/acre or 5%, Neem seed kernal extract (NSKE).</p>

	<p>Chemical management</p> <p>Spray of natural commercial pyrethrum extracts such as "Flower DS(r)" (Kenya), Ambush(r), Ammo(r), Aztec(r), Pounce(r) and Warrior(r) according to manufacturers recommendations.</p>
Justification	<p>Spider mites cause chlorotic speckled leaves thus compromising the quality of the crop. Under high infestations, the pest causes yield loss of up to 42%. Currently Potato 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 recommended because potato is consumed widely in Kenya. This involves the use of a combination of cultural practices and biopesticides that are relatively safe. The use of soft synthetic pesticides can be used as a last option. Adoption of an IPM approach would enhance food safety among the consumers and also contributes to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides Companies, CGIAR's</p>
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on insects by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension agents - mobilization/ sensitization of farmers and extension of the technology

	<ul style="list-style-type: none"> • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in pest management • PCPB - promote registration of insecticides for pest management • Universities - develop the technologies and conduct ToTs • Farmers/farmer groups - adopt the technologies • National and County Governments - development of enabling policies and create awareness • CGIAR/NGOs - link farmers to the market and lobby for changes in agriculture policies to favour the farmer • Financial institutions - provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Muranga, Embu. Meru, Nyandarua, Kiambu, Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMP will be up scaled	Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting potatoes and losses attributed to them • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Increased information dissemination on IPM strategies for insects • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Dissemination of IPM practices and safe use of pesticides • Establish potato innovation platforms for technology dissemination
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 50,000
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 42%. Net return KES 240,000 - 100,800 = KES 139,200
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge • Women are sometimes involved in spraying which may be unhealthy for them.
Gender related opportunities	Opportunities for youths exists in spraying the crop against spider mites.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for unemployed exists in spraying the crop against spider mites.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	<ol style="list-style-type: none"> 1. Infonet.biovision.org. 2. CABI. (2005). Crop Protection Compendium, 2005 Edition. (c) CAB International Publishing. Wallingford, UK. www.cabi.org. 3. EPPO. European and Mediterranean Plant Protection Organization www.eppo.org. 4. Henry Elwell & Anita Maas. Natural Pest & Disease Control. Natural Farming Network, Zimbabwe, P.O. Box 301, Causeway, Harare 1995. ISBN: 0-7974-1429-0. 5. Keizer, M. and Zurbier, J. Red Spider Mite. Namibian crop pests. 6. OISAT. Online Information Service for Non-Chemical Pest Management in the Tropics. www.oisat.org. 7. 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.


	8. Stoll, Gabriele (1988). Natural Crop Protection on the Tropics. AGRECOLE. c/o OKOZENTRUM, CH-4438 Langenbruck, Switzerland. 9. 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. 10. 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.
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST, Ogemah, V. CABI: Duncan Chacha
Partner organizations	CIP, CABI, ICIPE, KEPHIS, County Governments

GAPS:

1. Explore bio-control options for controlling the spider mites to minimize on pesticide use
2. Explore the efficacy of ITKs in management of spider mites under high pressure
3. Validation of tolerance of new potato cultivars to spider mites

2.6.7 Integrated Management of Leaf Miner

TIMP Name	Integrated Management of Leaf Miner (<i>Liriomyza huidobrensis</i>) of Potatoes
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Increased yield loss 30-70% and poor quality produce</p>  <p><i>Potato leafminer (Liriomyza huidobrensis)</i> Source; agrilearner.com</p>
What is it? (TIMP description)	<p>Integrated management of leaf miners consists of several approaches applied in an integrated manner to break the insect cycle. The following options can be applied;</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Plant clean seedlings free from all stages of the moth • Rotate with non-host crops such as maize, beans and cabbages • Remove and destroy wild host plants such as sodom apple around the farm • Remove and burn all infected crop residues • Remove infested leaves before the caterpillar pupates inside and becomes an egg-laying adult • Bury deep (50-100 cm) infested plants and foliage • Use black sticky traps - 24 pcs/acre, placed 15-20 cm above the ground <p>Biological options</p> <ul style="list-style-type: none"> • Use of <i>Bacillus thuringiensis</i> controls outbreaks • Pheromone traps: These will trap males, reducing males available for mating with females resulting into females laying unfertilized eggs thus no caterpillars. This can be purchased from Kenya Biologics- 0710724629 • Use black sticky traps from Koppert Kenya- 0723-144-690 <p>Chemical management</p> <p>Spray spinetoram (Radiant 120 SC(R)) at rate of 18-30ml/20lts of water or Chlorantraniliprol (Corragen 20 SC(R)) at rate of</p>

	2ml/20lts of water or Belt insecticide. Avoid using same active ingredient for more than 3 times in a season.
Justification	<p>Leaf miner causes considerable reduction in yield and lowers the seed (pod) quality. Where the pest is severe and not controlled, plants become greatly reduced in size and yield.</p> <p>Losses of up to 70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected.</p> <p>Currently potato 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.</p> <p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), Agripreneurs, research organizations and universities, as well as CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel/extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on insects by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects

	<ul style="list-style-type: none"> Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Public and private extension agents - mobilization/ sensitization of farmers and extension of the technology Farmers/CBO - participate in trainings and adoption of the technology KALRO - continually undertake research in insect management PCPB - promote registration of insecticides for insect management Universities - develop the technologies and conduct ToTs Farmers/farmer groups - adopt the technologies National and County Governments - development of enabling policies and create awareness CGIAR/NGOs - 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	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMP will be up scaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties.
Challenges in dissemination	<ul style="list-style-type: none"> Reluctance by farmers to adopt IPM technologies Inadequate knowledge on IPM strategies on insect pests infesting potatoes and losses attributed to them Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Increased information dissemination on IPM strategies for insects Scaling up participation of end-user in on-farm activities/adaptive research/extension activities Dissemination of IPM practices and safe use of pesticides Establish potato innovation platforms for technology dissemination
Lessons learned in up scaling if any	<ul style="list-style-type: none"> 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

	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Favorable environmental conditions Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality An increased number of producers willing to adopt recommended adopt the insect management practices Producers organized in groups to ensure that management practices are effectively up-scaled Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 50,000
Estimated returns	<p>When the farmer does not practice this TIMP yield will be reduced by 70%.</p> <p>Net return: KES 240,000 - 168,000 = KES 72,000</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> Women are sometimes involved in spraying which may be unhealthy for them Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men 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	<ul style="list-style-type: none"> Opportunities for youth exist in spraying the crop against leaf miner.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals 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 for unemployed exists in spraying the crop against leaf miner.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	CABI-Plantwise Knowledge Bank Infonet.biovision.org
F: Status of TIMP readiness (1-ready for upscaling; 2-	1-Ready for upscaling


requires validation; 3-requires further research)	
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha</p>
Partner organizations	MOALD, CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

GAPS

1. Explore bio-control options for controlling the potato leaf miner to minimize on pesticide use
2. Explore the efficacy of ITKs in management of potato leaf miner under high pressure
3. Validation of tolerance of new varieties to potato leaf miner

2.6.7 Integrated Management of Cutworms

TIMP Name	Integrated Management of Cutworms (<i>Agrotis ipsilon</i>) of Potatoes
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Potato cut worms cause between 20-30% yield losses on potato production.

	 <p><i>Potato cutworm(Agrotis ipsilon)</i> Source: infonet-biovision.org</p>
<p>What is it? (TIMP description)</p>	<p>Integrated management (IPM) of potato cutworms involves the use of a combination of cultural, biological and chemical control methods. These are:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • 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 Bt, or other insecticides e.g. pyrethrum • Use pheromone traps, ashes and sticky substances i.e. molasses <p>Biological options</p> <ul style="list-style-type: none"> • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) 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) <p>Chemical management Spray with Alpha Cypermethrin (Tata Alpha 10 EC-5ml/20 litres water, Lambda-cyhalothrin (Dududthrin, Rate-60ml/20L)</p>
<p>Justification</p>	<p>Cutworms cause considerable reduction in yield. Losses of above 30% are experienced due to the high pest infestation thus causing</p>

	<p>food security threat. Integrated Management of pests considering food safety concerns should be advocated considering that the potato is the 2nd 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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), Agripreneurs, research organizations and universities, as well as CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on insects by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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 - continually undertake research in insect management • PCPB - promote registration of insecticides for insect management • Universities - develop the technologies and conduct ToTs • Farmers/farmer groups to adopt the technologies • National and County Governments - development of enabling policies and create awareness • CGIAR/NGOs - 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	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMP will be up scaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance of farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting potato and losses attributed to them • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB to enhance registration of crop protection products • Training of stakeholders in IPM options • Establish potato 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 47,000 per acre
Estimated returns	<p>When the farmer does not practice this TIMP yield will be reduced by 30%.</p> <p>Net return: KES 240,000 - 72,000 = KES 168,000</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women and youth have limited access to education, training and extension services


	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youth exist in spraying the crop against cutworms.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for unemployed youth exist in spraying the crop against cutworms.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	<ul style="list-style-type: none"> • Infonet.biovision.org • CABI (2005). Crop Protection Compendium, 2005 Edition. (c) CAB International Publishing. Wallingford, UK. www.cabi.org. • Elwell, H. and Mass, A. (1995). Natural Pest and Disease Control. Published by the Natural Farming Network. Harare, Zimbabwe • Esbjerg, P. (1990). The significance of shelter for young cutworms (<i>Agrotis segetum</i>). <i>Entomologia Experimentalis et Applicata</i>, 54(2):97-100 • Hill, S. D. (1983). Agricultural insect pests of the tropics and their control. Second edition. Cambridge University Press. ISBN: 0-521-24638-5 • OISAT: Organisation for Non-Chemical Pest Management in the Tropics www.oisat.org • Seif, A.A., Varela, A. M., Michalik, S. and Lohr, B. (2001). A Guide to IPM in French beans production with emphasis on Kenya. ICIPE Science Press. ISBN: 92-9064-142-8 • Siddig, S. A. (1987). A proposed pest management program including neem treatments for combating potato pests in the Sudan. Proc. 3rd Int. Neem Conf. (Nairobi, Kenya, 1986). pp. 449-459 • Thygesen, Th. (1971). On the correlation between cutworm attacks, light trapping and weather conditions. <i>Danish Journal of Plant and Soil Science</i>, 75:807-815 • Varela, A. M. and Seif, A.A. (2004). A Guide to IPM and Hygiene Standards in Okra Production in Kenya. ICIPE Science Press. ISBN: 92-9064-161-5
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling

G: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	<p>KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H.</p> <p>MMUST: Ogemah, V.</p> <p>CABI: Duncan Chacha</p>
Partner organizations	MOALD, CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

GAPS:

1. Capacity building on cutworm identification and management
2. Validation of biopesticides and synthetic pesticides in the management of cutworm
3. Determine the effects of major pests on potato yield, quality and implication on economic returns for the farmer

2.6.8 Integrated Management of Millipedes

TIMP Name	Integrated Management of Millipedes (<i>Blaniulus guttulatus</i>) of Potato
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Millipedes infestation on potato can reduce yield by up to 80%.</p>  <p><i>Millipedes (Blaniulus guttulatus)</i> Source: infonet-biovision.org</p>

What is it? (TIMP description)	<p>Integrated management (IPM) of potato millipedes involves the use of a combination of cultural, biological and chemical control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Avoid practices that increase soil moisture above that required by the crop • Clear hiding places • Remove volunteer plants, crop residues, decaying vegetation, dead leaves, grass, compost piles, excess mulch or other similar debris • Avoid planting wet areas • Use beer in bowls as traps and destroy the millipedes after attraction • Apply Entomopathogenic nematodes (<i>Steinernema feltiae</i>) at 0.5 million nematodes/m² <p>Chemical management</p> <ul style="list-style-type: none"> • Seed dress with Thiomethoxan + Metalaxyl –M + Difenoconazole such APRON STAR at 250g/100kg seed at planting time • Apply lambda-cyhalothrin such as Karate 2.5 WG at 20g/20lts of water • Apply deltamethrins such as Decis® EC 50 at 245-490 litres/acre
Justification	<p>Where the pest is severe and not controlled, plants become greatly reduced in size and yield. Losses of 100% are experienced due to the pest. Currently potato farmers use a lot of synthetic pesticides in their control. Integrated Management of pests considering food safety concerns should be highly advocated due to environmental safety. 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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), Agripreneurs, research organizations and universities, as well as CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings

	<ul style="list-style-type: none"> • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on insects by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension agents 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	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMP will be up scaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting potatoes and losses attributed to them • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB to enhance registration of crop protection products • Training of stakeholders in IPM options • Establish potato 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 50,000 per acre
Estimated returns	<p>When the farmer does not practice this TIMP yield will be reduced by 80%.</p> <p>Net return: KES 240,000 - 192,000 = KES 48,000</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop against pests.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for unemployed exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	CABI-Plantwise Knowledge Bank Infonet.biovision.org
F: Status of TIMP readiness (1-ready for upscaling;, 2-	Requires further research

requires validation; 3-requires further research)	
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha</p>
Partner organizations	MOALD, CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

GAPS:

1. Capacity building on insect identification and management

2.6.9 Integrated Management of Slugs

TIMP Name	Integrated Management of Slugs (<i>Limax maximus</i>) of potatoes
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Reduces quality of potato produce.</p>  <p><i>Slugs (Limax maximus)</i> Source: fginsight.com</p>
What is it? (TIMP description)	<p>Integrated management (IPM) of slugs involves the use of a combination of cultural methods. These are:</p> <p>Cultural practices</p>

	<ul style="list-style-type: none"> • Inspect plants for feeding damage and slime trails • Clean up weeds and plant debris • Remove rocks and anything that can shelter the slugs • Hand pick and kill slugs • Trap slugs with shallow containers of beer, molasses or yeast and sugar solution sunk into the ground • Place large cabbage leaves on the ground, allow slugs to start eating them, and then collect the leaves with the slugs and throw both in the trash • Put up a vertical copper barrier at least 10cm tall around the strawberry bed. Half of the barrier should be inside the ground so slugs won't burrow under it
Justification	Slugs cause considerable reduction in yield and lower the quality potato. Where the pest is severe and not controlled, plants become greatly reduced in size and yield. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that potato is very widely consumed in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IPM technologies on pests by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension agents - mobilization/ sensitization of farmers and extension of the technology • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in insect management • PCPB - promote registration of insecticides for insect management • Universities - 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	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo.
Counties where TIMP will be up scaled	Counties with high potential for upscaling Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting potatoes and losses attributed to them • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB to enhance registration of crop protection products • Training of stakeholders in IPM options • Establish potato 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices




	<ul style="list-style-type: none"> Producers organized in groups to ensure that management practices are effectively up-scaled Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 15,000 per acre
Estimated returns	<p>When the farmer does not practice this TIMP yield quality will be reduced by 100%.</p> <p>Net return: KES 240,000 - 240,000 = KES 0</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals Women have limited access to education, training and extension services Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals 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 for unemployed exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	<p>CABI-Plantwise Knowledge Bank</p> <p>Infonet.biovision.org</p>
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	<ol style="list-style-type: none"> Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org

	www.kalro.org
Lead organization and scientists	KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha
Partner organizations	MOALD, CIP, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

GAPS:

1. Capacity building on slug identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato pests
3. Determine the effects of major pests on potato yield, quality and implication on economic

2.6.10 Integrated Management of Bacterial Wilt

2.6.16 Integrated Management of Bacterial Wilt		
Technology Name	Integrated Management of Bacterial Wilt (BW)	
Category (i.e. technology, innovation or management practice)	Management practice	
A: Description of the technology, innovation or management practice		
Problem to be addressed	<div></div> <p>Yield loss of up to 50-100% due infection of potato by Bacterial wilt disease caused by <i>Ralstonia solanacearum</i>.</p>	
What is it? (TIMP description)	<p>Integrated management of bacterial wilt disease is the combined application of cultural and chemical approaches to break the disease cycle. They include:</p> <p>Cultural practices</p> <ul style="list-style-type: none">• Use tolerant varieties or clean potato seed to plant• Avoid planting capsicum, eggplant, potato, tomato and tobacco on the affected soil for a period of at least 3 years since they are alternative host for the pathogen• Practice crop rotation with non-solanaceae crops like maize, beans, carrots, garden peas, onions, spinach, cabbages, kales, strawberry, karella, courgettes and sweet potatoes as you may find appropriate	

	<ul style="list-style-type: none"> • After cleaning the infected field, always keep the field free from weeds as some act as alternate hosts to the bacteria • Control run-off water coming from infected areas to avoid bacteria from spreading to uninfected areas • Uproot and destroy (e.g. by burying) all the diseased plants as soon as they are detected • Disinfect farm implements (e.g. pangas, jembes, ploughs, gumboots, shoes/boots, pegs and sprinkler stands) before using in clean fields. A jik solution (dilution of 500ml in 10 litres of water) can be used for washing the implements to prevent the spread of the bacterium to other areas <p>Biological options Spray Azadirachtin 10000 ppm (Fortune AZA 0.3EC, Achook EC, spinosad)@ 3 ml/litre of water, to control beetles (disease disseminators).</p> <p>Chemical management</p> <ul style="list-style-type: none"> • Spray copper-based fungicide like copper oxychloride (Amicop 50WP or Cobox 50WP at 60g per 20L water). Repeat spray after 2 weeks • Drench with Carbendazim 500g/L (Rodazim SC, BOTRAN 500SC, SAHARA 500SC, PEARL 80DF) Max. 3 sprays over 4-8 weeks, PHI 14 days, REI 3 days
Justification	Bacterial wilt can cause considerable yield reduction in potato. Where the disease is severe and not controlled, plants become die leading to reduced yield. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Integrated Management of this disease should be highly advocated considering that potato is very widely consumed in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural shows, • Use of digital platforms, • Print media promotional materials (posters, brochures, leaflets and manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM technologies on BW by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage insects • Reliable production, storage and distribution of certified seed potato at farm level • Mapping of BW free zones for up and out scaling of certified seed potato production
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) - Collaborative research on potato variety development • 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 • GIZ - Nutrition and potato utilization by the communities • 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 disease management • PCPB to promote registration of pesticides for disease 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	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho.</p> <p>Emerging potato producing counties in mid-altitude AEZ (Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi.</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IDM technologies • Non-exposure of the end-user to bacterial wilt and its management strategies • Inadequate knowledge on IPM strategies on insect pests infesting potatoes and losses attributed to them

	<ul style="list-style-type: none"> • Poor linkages among stakeholders in potato value chain
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • PCPB to enhance registration of crop protection products • Training of stakeholders in IPM options • Establish potato 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	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination • Sensitization is necessary for people to appreciate the use of IDM in bacterial wilt disease management • Adoption of good agricultural practices by farmers is key in management of the disease • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 55,000 per acre
Estimated returns	<p>When the farmer does not practice this TIMP yield quality will be reduced by 100%.</p> <p>Net return: KES 240,000 - 240,000 = KES 0</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop against bacterial wilt.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for unemployed exists in spraying the crop against bacterial wilt.


E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	<ol style="list-style-type: none"> 1. CABI-Plantwise Knowledge Bank 2. https://infonet-biovision.org/PlantHealth/Pests/Bacterial-wilt 3. https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS

1. Capacity building on bacterial wilt identification and management
2. Validation of biopesticides and synthetic pesticides in the management of bacterial wilt
3. Determine the effects of bacterial wilt on yield, quality and implication on economic returns for the farmer

2.6.11 Integrated Management Late Blight Disease

Technology Name	Integrated Management Late Blight Disease (<i>Phytophthora infestans</i>)
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Yield losses of up to 67% due to infection by potato late blight</p>  <p>Potato leaves showing potato late blight disease</p> <p><i>Source: Patrick Pwaipwai</i></p>
What is it? (TIMP description)	<p>Integrated management of potato late blight consists of several approaches applied in an integrated manner to break the cycle of the disease. These include:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use of clean certified seed free from diseases from certified dealers • Do not plant next to infected field • Destroy crop debris after harvest by deep burying or by burning • Practice rotation with beans, maize, sorghum, millet, cowpeas, onion, sweet potatoes, carrots. • Intercrop with millet, maize, cotton, sorghum and soy bean to reduce spread of spores • Disinfect tools with sodium hypochlorite (Jik at 5mls/L of water) • Regularly weed the fields to reduce humidity to reduce the inoculum • If plants are infected, remove and burn or bury in the soil. Do not compost • Use dry mulch to avoid spread of disease • Avoid planting capsicum, eggplant, potatoes, tomatoes and tobacco on the affected soil for a period of at least 3 years • Use tolerant varieties or clean potato seed to plant <p>Biological options</p> <ul style="list-style-type: none"> • Use of botanical controls such as fermented marigold and onion bulb extracts • Spray with baking soda (3 tablespoons in 4 litres of water; add 1 tablespoon of cooking oil to aid as sticker) <p>Chemical management</p> <ul style="list-style-type: none"> • Spray Mancozeb e.g Oshothane, Fantic, Dithane M45 at 50g/20l water. Spray Oshothane every 7 days and alternate with Dithane M45 to prevent development of resistance

	<ul style="list-style-type: none"> • Spray Copper hydroxide eg Champflo at 50g.20l of water or Copper oxychloride such as cobox WP at the rate of 40- 80 g per 20l when you notice brown spots on the leaves. • Spray Metalaxyl eg Ridomil gold rate of 50gms/ 20L of water
Justification	The use of the Integrated disease management approach can lead to significant reduction of Late blight disease hence minimizing yield losses due to crop infection by the disease. IPM strategies is less hazardous to the environment, producers and consumers hence, increases potato yield thereby promoting food security, safety and income generation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM practices of late blight disease by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - development of enabling policies and creating awareness • CIP (International Potato Centre) - Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities

	<ul style="list-style-type: none"> • 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 disease management • PCPB to promote registration of pesticides for disease management • Universities to develop the technologies and conduct ToTs. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where up-scaled if any	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho</p> <p>Emerging potato producing counties in mid-altitude AEZ - Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado and Nairobi.</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IDM technologies • Non-exposure of the end-user to late blight and its management strategies • Inadequate knowledge on IDM technologies • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Training of stakeholders in Late blight IDM strategies • Scaling up participation of end-user in on-farm activities adaptive research and extension activities • PCPB to enhance registration of crop protection products • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination • Sensitization is necessary for people to appreciate the use of IDM in Late blight disease management • Adoption of good agricultural practices by farmers is key in management of the disease • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Regulatory bodies e.g. PCBPB, KBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	


Basic costs	Estimated cost of management options at KES 43,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 67%. Net return: KES 240,000 - 160,800 = KES 79,000
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youth exist in spraying the crop against late blight.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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 for unemployed exists in spraying the crop against late blight.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	<ol style="list-style-type: none"> 1. CABI-Plantwise Knowledge Bank 2. https://infonet-biovision.org/PlantHealth/Pests/Late-blight 3. https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for up-scaling
F: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org


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Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS

1. Capacity building on late blight disease identification and management
2. Validation of biopesticides and synthetic pesticides in the management of late blight disease
3. Determine the effects of late blight disease on yield, quality and implication on economic returns for the farmer

2.6.11 Integrated Management of Potato Blackleg disease

Technology name	Integrated Management of Potato Blackleg disease
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Low potato yields due to infection by potato blackleg disease</p>  <p><i>Inky black decay on lower stem portion, or "leg", of the plant</i> (Source: KEPHIS, Eunice Lingeera)</p>

	 <p><i>Chlorotic foliage and leaflets rolled upwards at the margins.</i> (Source: KEPHIS, Eunice Lingeera)</p>
What is it? (TIMP description)	<p>Integrated management of potato blackleg disease consists of several approaches applied in an integrated manner to break the cycle of the disease. These include:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Plant disease free seed tubers sourced from certified growers like KALRO Tigoni, ADC Molo, Kisima farm • Plough deep to reduce the inoculum and improve soil drainage • Remove affected crop and debris after harvest and burn • Control roots and tuber chewing pests like tuber moth, nematodes - see yellow section • Rotate with maize, legumes, soybeans and fodder grasses • Remove and burn infected materials • Disinfect farm implements (e.g. pangas, jembes, ploughs, gumboots) in a jik solution (dilution of 500 ml in 10 litres of water) before using <p>Bio- control options</p> <p>Drench the plants with Trichoderma based biopesticide such as Rootgard at the rate of 100ml in 20 litres, Trianum–P 11.5 WP, Trichotech, Bio cure-F 1.5 WP and Mazao Sustain.</p> <p>Chemical management</p> <ul style="list-style-type: none"> • Spray copper-based fungicide like copper oxychloride (Amicop 50 WP or Cobox 50WP at 60g per 20L water). Repeat spray after 2 weeks • Drench with Azadirachtin-based products like Fortune AZA 0.3 EC, Nimbecidine EC or Achook EC at 50mls/20L of water
Justification	<p>The use of the Integrated disease management approach can lead to significant reduction in black leg disease incidences in potato hence minimizing yield losses. IPM strategies are less hazardous to the environment, producers and consumers hence, increases potato yield thereby promoting food security, safety and income generation.</p>
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM practices of potato blackleg disease by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - development of enabling policies and create awareness • CIP (International Potato Centre) - Collaborative research on potato variety development • ICIPE (International Centre - 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 • GIZ - Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in disease management • PCPB - promote registration of pesticides for disease management • Universities to develop the technologies and conduct ToTs • Financial institutions - provide credit facilities • Public and private extension agents - mobilization/sensitization of farmers and extension of the technology
C: Current situation and future scaling up	
Counties where up-scaled if any	Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma,

	West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho Emerging potato producing counties in mid-altitude AEZ - Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IDM technologies • Non-exposure of the end-user to potato blackleg disease and its management strategies • Inadequate knowledge on IDM technologies on potato diseases and losses attributed to them • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on potato blackleg integrated disease 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 potato production. • PCPB enhance registration of crop protection products • Training of stakeholders in IDM options • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination • Sensitization is necessary for people to appreciate the use of IDM in potato blackleg disease management • Adoption of good agricultural practices by farmers is key in management of the disease • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Regulatory bodies e.g. PCBPB, KBS to ensure pesticides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 50,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 50%. Net return: KES 240,000 - 120,000 = KES 120,000


Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop against potato blackleg disease
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Some VMGs such as women are sometimes involved in spraying which may be unhealthy for them. • Opportunities for unemployed exists in spraying the crop against potato blackleg disease
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	<ol style="list-style-type: none"> 1. CABI-Plantwise Knowledge Bank 2. https://infonet-biovision.org/PlantHealth/MinorPests/Black-leg 3. https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org

Lead organization and scientists	KALRO: Nyongesa M., Mbiyu M., Otieno S., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on potato blackleg disease identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato blackleg disease
3. Determine the effects of potato blackleg disease on yield, quality and implication on economic returns for the farmer

2.6.11 Integrated Management Soft Rot Disease

Technology name	Integrated Management Soft Rot Disease
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	<p>Yield losses of up to 30% due to infection by soft rot disease</p>  <p><i>Soft, wet portions on tubers.</i> <i>Source: Dr Eugenia Banks, Ontario Potato Board</i></p>



Soft, wet, rotted and cream to tan coloured tubers

Source: KEPHIS, Eunice Lingeera



Blackish mushy lower stems, chlorotic foliage and rolled leaflets

Source: KEPHIS, Eunice Lingeera

What is it? (TIMP description)

Integrated management of soft rot consists of various approaches including cultural, biological and chemical control that help to break the disease cycle. Disease is effectively managed by controlling insect infestations

Cultural practices

- Plant pathogen-free seed tubers sourced from certified growers like KALRO Tigoni, ADC Molo, Kisima farm
- Harvest mature tubers with low pulp temperature and well-set skins
- Avoid storing wet tubers and allow adequate air flow to promote drying
- Avoid harvesting during wet periods to reduce lenticel infection
- Disinfect seed harvesting tools in 10% jik solution (50 mls in 1 litre) of water for 5 minutes
- Crop rotation with non-legumes for 6-8 seasons
- Practicing proper field hygiene
- Avoid excessive watering of plants when irrigating
- Avoid surface run off as it spreads the pathogen to non-infected areas
- Uprooting infected plants and burying deeply to reduce inoculum
- Apply farm yard manure or green leaf manure (*Gliricidia maculate*) at 10 t/ha

Biological options

	<p>Drench the plants with Trichoderma based biopesticide such as Rootgard at the rate of 100ml in 20 litres, Trianium–P 11.5 WP, Trichotech, Bio cure-F 1.5 WP and Mazao Sustain.</p> <p>Chemical Control</p> <ul style="list-style-type: none"> • Spray copper-based fungicide like copper oxychloride (Amicop 50WP or Cobox 50WP at 60g per 20L water). R.E.I 3 days. Repeat spray after 2 weeks • Drench with Azadirachtin-based products like Fortune AZA 0.3EC, Nimbecidine EC or Achook EC at 50mls/20L of water with an re entry interval of 1 day
Justification	Soft rot disease is a major challenge in potato production in Kenya, occurring in all major production areas. Failure to observe crop rotation would lead to higher severity cases and spread of the disease. Integrated Disease Management is an environmentally friendly approach that enables the control of the disease through recommended cultural practises, use of biopesticides and synthetic pesticides where high severity is observed.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM technologies on diseases by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) - development of enabling policies and create awareness

	<ul style="list-style-type: none"> • CIP (International Potato Centre) - Collaborative research on potato variety development • 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 • GIZ - Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) CARE Kenya - Farmer Input Promotion • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in disease management • PCPB - promote registration of pesticides for disease management • Universities - develop the technologies and conduct ToTs • Financial institutions to provide credit facilities • Public and private extension agents - mobilization/sensitization of farmers and extension of the technology
C: Current situation and future scaling up	
Counties where up-scaled if any	<p>Traditional potato producing counties - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho</p> <p>Emerging potato producing counties in mid-altitude AEZ - Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado and Nairobi.</p>
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu as prioritized by counties.
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IDM technologies • Non-exposure of the end-user to bacterial wilt and its management strategies • Inadequate knowledge on IDM strategies for soft rot disease • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on soft rot IDM strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • PCPB enhance registration of crop protection products • Training of stakeholders in IDM options • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination


	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IDM in soft rot disease management • Adoption of good agricultural practices by farmers is key in management of the disease • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality • An increased number of producers willing to adopt recommended adopt the insect management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 51,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield will be reduced by 30%. Net return: KES 240,000 - 72,000 = KES 168,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop against soft rot disease.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Some VMGs such as women are sometimes involved in spraying which may be unhealthy for them • Opportunities for unemployed exists in spraying the crop against soft rot disease
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • https://infonet-biovision.org/PlantHealth/MinorPests/Bacterial-soft-rot-2 • https://npck.org/Books/potato%20production%20manual.pdf
F: Status of TIMP readiness (1-ready for	1-Ready for up-scaling

up-scaling; 2-requires validation; 3-requires further research)	
F: Contacts	
Contacts	<p>1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO: Nyongesa M., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H. MMUST: Ogemah, V. CABI: Duncan Chacha</p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on soft rot disease identification and management
2. Validation of biopesticides and synthetic pesticides in the management of soft rot disease
3. Determine the effects of soft rot disease on yield, quality and implication on economic returns for the farmer

2.6.12 Integrated Management of Potato Leaf Roll Virus

Technology Name	Integrated Management of Potato Leaf Roll Virus (PLRV)
Category (i.e. technology, innovation or management practice)	<p>Management practice</p>  <p><i>Potato leaves affected by potato leaf roll virus</i></p> <p>Source:</p>
A: Description of the technology, innovation or management practice	

Problem to be Addressed	The effect of viral infection on potato is gradual and increases through subsequent seasons when seed is recycled. This may lead to complete crop failure in severe viral infections.
What is it? (TIMP description)	<p>Integrated management of Potato Leaf Roll Virus (PLRV) disease of potato consists of various approaches that help to break the disease cycle. They include good cultural practices and chemical control. Potato Leaf Roll Virus (PLRV) disease of potatoes is transmitted by aphids.</p> <p>The disease is can be managed by the following options:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use of certified seed • Monitoring insect vectors that transmit the viruses • Avoiding work on fields when wet to prevent spread • Uprooting weeds that could serve as alternative hosts • Grow tolerant potato variety such as Unica, Shangi, Wanjiku, Chulu and Kenya Mpya <p>Chemical management</p> <p>Spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml in 500 lit of water.</p>
Justification	The use of the Integrated disease management approach can lead to significant reduction in incidences of potato viruses and minimize yield losses. IPM strategies are environment friendly to producers and consumers and leads to increase of potato yield thereby promoting food security, safety and income generation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion

	<ul style="list-style-type: none"> • Need to validate integrated management practices of potato leaf roll virus by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - for development of enabling policies and create awareness • CIP (International Potato Centre) - Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) CARE Kenya - Farmer Input Promotion • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in disease management • PCPB - promote registration of pesticides for control of viral vectors • Universities to develop the technologies and conduct ToTs • Financial institutions to provide credit facilities • Public and private extension agents - mobilization/sensitization of farmers and extension of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	Not widely distributed
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Reluctance by farmers to adopt IDM technologies • Inadequate knowledge on IDM for potato leaf roll virus • Poor linkages among stakeholders in potato value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on potato leaf roll virus management strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • PCPB enhance registration of crop protection products • Training of stakeholders in IDM options • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination

	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IDM in potato leaf roll virus management • Adoption of good agricultural practices by farmers is key in management of the diseases • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Regulatory bodies e.g. PCPBP, KBS to ensure pesticides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Available and affordable farm inputs for farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 33,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield quality will be reduced by 60%. Net return: KES 240,000 - 144,000 = KES 96,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop against Potato Leaf Roll Virus (PLRV).
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Some VMGs such as women are sometimes involved in spraying which may be unhealthy for them • Opportunities for unemployed exists in spraying the crop against Potato Leaf Roll Virus (PLRV)
E: Case studies/profiles of success stories	
Success stories from Previous similar projects	-
Application guidelines for users	<ol style="list-style-type: none"> 1. CABI-Plantwise Knowledge Bank 2. https://infonet-biovision.org/PlantHealth/MinorPests/Viral-diseases-0 3. Onditi, J., Nyongesa, M. & van der Vlugt, R. Prevalence, distribution and control of six major potato viruses in Kenya. Trop. plant pathol. 46, 311–323 (2021). https://doi.org/10.1007/s40858-020-00409-x


F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and Scientists	<p>KALRO: Nyongesa M., Mbiyu M., Otieno S., Oyoo J., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H.</p> <p>MMUST: Ogemah, V.</p> <p>CABI: Duncan Chacha</p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on potato leaf roll virus disease identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato leaf roll virus disease
3. Determine the effects of potato leaf roll virus disease on yield, quality and implication on economic returns for the farmer

2.6.13 Integrated Management of Potato Virus Y

Technology name	Integrated Management of Potato Virus Y(PVY)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	The effect of viral infection on potato is gradual and increases through subsequent seasons when seed is recycled. This may lead to complete crop failure in severe viral infections.

	 <p><i>Potato virus Y (PVY)</i> (Source: KALRO)</p>
What is it? (TIMP description)	<p>Potato virus Y (PVY) disease is transmitted by aphids. This disease can effectively be managed by controlling aphid population. Integrated management of Potato Virus Y (PVY) disease of potatoes consists of various approaches. These include good cultural practices, use of biopesticides and synthetic pesticides.</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use of certified seed • Monitoring insect vectors (aphids) that transmit the viruses • Avoiding work on fields when wet to prevent spread of viruses to healthy plants • Uprooting weeds that may serve as alternative hosts • Grow tolerant potato variety such as Unica, Shangi, Wanjiku, Chulu and Kenya Mpya <p>Chemical management</p> <p>Spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml in 500 lit of water.</p>
Justification	<p>Integrated Disease Management is an environmentally friendly approach that enables the control of viral disease by applying good cultural practices, biopesticides and synthetic pesticides.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers</p>
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets

	<ul style="list-style-type: none"> • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM practices by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) - development of enabling policies and create awareness • CIP (International Potato Centre) - Collaborative research on potato variety development • 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 • GIZ - Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) CARE Kenya - Farmer Input Promotion • Farmers/CBO - participate in trainings and adoption of the technology • KALRO - continually undertake research in disease management • PCPB - promote registration of pesticides for control of viral vectors • Universities - develop the technologies and conduct ToTs • Financial institutions - provide credit facilities • Public and private extension agents - mobilization/sensitization of farmers and extension of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate availability and accessibility of information on managing the disease • Non-exposure of the end-user to potato virus Y disease and its management strategies • Unwillingness of farmers to adopt IDM technologies • Inadequate knowledge on IDM strategies

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on potato virus Y disease 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 potato production. • PCPB enhance registration of crop protection products • Training of stakeholders in IDM options • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination • Sensitization is necessary for people to appreciate the use of IDM in potato virus Y management • Adoption of good agricultural practices by farmers is key in management of the disease • Upscaling will be higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Regulatory bodies e.g. PCBPB, KBS to ensure pesticides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 33,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield quality will be reduced by 60%. Net return: KES 240,000 - 144,000 = KES 96,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to inputs such as chemicals than men • 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	Opportunities for youths exists in spraying the crop against potato virus Y (PVY).
VMG issues and concerns in development,	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services


dissemination, adoption and scaling up	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Some VMGs such as women are sometimes involved in spraying which may be unhealthy for them • Opportunities for unemployed exists in spraying the crop against potato virus Y (PVY)
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • https://infonet-biovision.org/PlantHealth/MinorPests/Viral-diseases-0 • Onditi, J., Nyongesa, M. & van der Vlugt, R. Prevalence, distribution and control of six major potato viruses in Kenya. Trop. plant pathol. 46, 311–323 (2021). https://doi.org/10.1007/s40858-020-00409-x
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1. Ready for up-scaling
F: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	<p>KALRO: Nyongesa M., Mbiyu M., Otieno S., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H.</p> <p>MMUST: Ogemah, V.</p> <p>CABI: Duncan Chacha</p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on potato virus Y disease identification and management

2. Validation of biopesticides and synthetic pesticides in the management of potato virus Y disease
3. Determine the effects of potato virus Y disease on yield, quality and implication on economic returns for the farmer

2.6.14 Integrated Management of Potato Virus X

Technology Name	Integrated Management of Potato Virus X(PVX)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be Addressed	<p>Yield loss due to infection of potato by the disease</p>  <p><i>Potato virus Y (PVY)</i> Source: KALRO</p>
What is it? (TIMP description)	<p>Integrated management of Potato Virus X (PVX) disease of potatoes consists of various approaches that help to break the disease cycle. They include cultural management and chemical control. Potato virus X (PVX) disease of potatoes is associated with aphid and white fly that transmit the virus. The disease is effectively managed by controlling insect infestations as follows;</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use of certified seed • Monitoring insect vectors (aphids and white flies) that transmit the viruses • Avoiding work on fields when wet to prevent spread • Uprooting weeds that could serve as alternative hosts • Grow tolerant potato variety such as Unica, Shangi, Wanjiku, Chulu and Kenya Mpya <p>Chemical management Spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml in 500 lit of water.</p>
Justification	Integrated Disease Management is an environmentally friendly approach that enables the control of viral disease by applying good cultural practices, biopesticides and synthetic pesticides.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Agripreneurs, Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A strong partnership between technical personnel /extension, companies producing biological control and biopesticides products and farmers would enhance promotion • Need to validate IDM practices to control Potato Virus X disease by research and extension • Existing platforms of stakeholders for capacity building, interaction and promotion • Formation of spray service providers (teams) to manage diseases • Reliable production, storage and distribution of certified seed potato at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) - development of enabling policies and create awareness • CIP (International Potato Centre) – Collaborative research on potato variety development • 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 • GIZ- Nutrition and potato utilization by the communities • 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 disease management • PCPB to promote registration of pesticides for control of viral vectors • Universities to develop the technologies and conduct ToTs. • Financial institutions to provide credit facilities • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology
C: Current situation and future scaling up	

Counties where already promoted if any	-
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Big challenge between information availability and accessibility • Non-exposure of the end-user to potato virus X disease and its management strategies • Unwillingness of farmers to adopt IDM technologies • In adequate knowledge on IDM strategies
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on potato virus X disease management strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • PCPB enhance registration of crop protection products • Training of stakeholders in IDM options • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP is important in technology dissemination • Sensitization is necessary for people to appreciate the use of IDM in potato virus X management • Adoption of good agricultural practices by farmers is key in management of the disease • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Regulatory bodies e.g. PCBPB, KBS to ensure pesticides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated cost of management options at KES 33,000 per acre
Estimated returns	When the farmer does not practice this TIMP yield quality will be reduced by 60%. Net return: KES 240,000 - 144,000 = KES 96,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women are sometimes involved in spraying which may be unhealthy for them • Women and youth have limited access to inputs such as chemicals • Women have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in spraying the crop against potato virus X (PVX)

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • 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	<ul style="list-style-type: none"> • Some VMGs such as women are sometimes involved in spraying which may be unhealthy for them. • Opportunities for unemployed exists in spraying the crop against potato virus X (PVX)
E: Case studies/profiles of success stories	
Success stories from Previous similar projects	-
Application guidelines for users	<ol style="list-style-type: none"> 1. CABI-Plantwise Knowledge Bank 2. https://infonet-biovision.org/PlantHealth/MinorPests/Viral-diseases-0 3. Onditi, J., Nyongesa, M. & van der Vlugt, R. Prevalence, distribution and control of six major potato viruses in Kenya. Trop. plant pathol. 46, 311–323 (2021). https://doi.org/10.1007/s40858-020-00409-x
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	<p>KALRO: Nyongesa M., Mbiyu M., Otieno S., Oyoo J., M., Otipa M., Amata R., Ndubi, J., Otieno B., Orayo M., and Odhiambo H.</p> <p>MMUST: Ogemah, V.</p> <p>CABI: Duncan Chacha</p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

GAPS:

1. Capacity building on potato virus X disease identification and management
2. Validation of biopesticides and synthetic pesticides in the management of potato virus X disease
3. Determine the effects of potato virus X disease on yield, quality and implication on economic returns for the farmer.

2.6.15 LAMP Technology for rapid detection of Bacterial Wilt, Dikeya and Viruses in Potato

TIMP name	LAMP Technology for Rapid Detection of Bacterial Wilt, Dikeya and Viruses in potato
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	<p>Lack of simple, cost effective, accurate and rapid assays for disease detection and monitoring production of the health status of pre-basic seed.</p> <p>Delayed or inaccurate detection of these pathogens</p> <p>Risk of samples deteriorating if the testing facilities are far from the sampling points.</p>
What is it? (TIMP description)	Loop Mediated Isothermal Amplification (LAMP) is rapid diagnostic tool for determining the quality status of seed potato production facility. It enables detection of low density and sub-microscopic infections with better accuracy and greater ease.
Justification	Accurate and timely diagnosis of bacterial wilt, dikeya and viruses in potato is important for quick implementation of correct management strategies and prevention of the spread of quarantine pathogens in many fields. In addition, an efficient, economical, accurate, sensitive and specific diagnostic tool is necessary for the management of plant diseases.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Seed producers, Exporters, Processors, Extension service providers, Agripreneurs, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)





Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of personnel in tissue culture laboratories and nurseries for rooted cuttings. • Enhancing accessibility of LAMP equipment and testing supplies.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to continue undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • Seed companies to adopt this technology • Financial institutions to provide credit facilities for acquisition of the LAMP equipment.
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties where seed potato is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Scarcity of LAMP equipment. • Lack of awareness among seed producers on the application of this technology.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhancing accessibility of LAMP equipment and testing supplies • Capacity building of personnel in tissue culture laboratories and nurseries for rooted cuttings.
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Adoption of this technology by the producers is key in the effective management of these diseases • Participatory and seed producer-centered approaches enhance technology adoption
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Potato seed producers' willingness to adopt the technology • Understanding the physical and biotic environment of the diseases. • Training of seed producers on LAMP technology to increase awareness of the technology and its contribution to reduction of disease related challenges.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Most of the seed producing entities where this technology is applied are dominated by men compared with women • Women have limited access to training and extension services • Women have less access to knowledge and technology than men.
Gender related opportunities	Opportunities for educated youth technical scientists to be employed by the seed producers to implement the technology.

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Most of the seed producing entities where this technology is applied are dominated by men compared with women • Women limited access to training and extension services • Women have less access to knowledge and technology than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	Opportunities for educated young technical scientists to be employed by the seed producers to implement the technology.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	<ol style="list-style-type: none"> 1. Centre Director - Food Crops KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org 2. Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	KALRO-Kabete, Moses Nyongesa., Mbiyu M., Otieno S., Miriam Otipa., Ruth Amata., Daniel Mutisya., Nzioki C., Harun Odhiambo, Mercyline Orayo, Berrick Otieno and Rael Karimi
Partner organizations	ICRAF, CABI, KEPHIS Extension service providers, CGIAR, NGOs

2.7 Weed Management in Potato Production

2.7.1 Integrated Weed Management

Technology name	Integrated Weed Management (IWM) in potato
Category (i.e. technology, innovation)	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	High incidence of difficulty to control annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control them leads to low and poor quality yields.		
What is it? (TIMP description)	Integrated weed management (IWM) is the management of weeds using several weed approaches such as preventive, physical control, biological control, mulching, cultural, mechanical and chemical control. Physical/ manual control is manual or mechanical removal of weeds. Biological control is use of live organisms such as insects, pathogen or animals (graze on the weeds) to control weeds. Chemical control is use of appropriate herbicides control weeds while Cultural control is weed control by methods such as crop rotation and intercropping.		
	Common weeds and those difficult to control in potato		
	 <p>Wondering jew (<i>Commelina benghalensis</i>)</p>	 <p>Yellow nut sedge (<i>Cyperus esculentus</i>)</p>	
	 <p>Couch grass (<i>Cynodon dactylon</i>)</p>	 <p>Purslane (<i>Portulaca oleracea</i>)</p>	
	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 potato production. Weeds compete with the crop for growth resources such as nutrients, soil moisture, space and sunlight Some key weed grass species include difficult to control couch grass (<i>Cynodon dactylon</i>). Common broad leaved weeds include sow thistle (<i>Sonchus oleraceae</i>), Black jack (<i>Bidens pilosa</i>), and Starbur (<i>Acanthospermum hispidum</i>). Weeds such as Amaranthus species eg Red pigweed (<i>A. retroflexus</i>), Sedges such as Yellow nutsedge (<i>Cyperus esculentus</i>), Wondering jew (<i>Commelina benghalensis</i>), Witchweed (<i>Striga hermonthica</i>) and Ragweed (<i>Parthenium hysterophorus</i>) are difficult to control in potato fields where they have succeeded because of re-grow through cuttings. There is therefore the need to apply IWM approach to control the biodiversity of weeds in potatoes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension workers, Agrodealers, Agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release IPM in potato varieties • A platform for interaction of potato value chain stakeholders • Promotion and training on integrated weed management (IWM). • Address environmental and safety concerns related to use of herbicides • Combine promotion with demos and field days with farmer groups and stakeholders on the effectiveness of various weed management options using FFSB approach. • Train users on appropriate and safe use of herbicide. • Train stakeholders on weed identification and dynamics in cropping systems. • While using pesticides farmers need to preserve pollinators.
Partners/ stakeholders for scaling up and their respective roles	Agrochemical companies, Agro-dealers, Research partners (KALRO, County extension staffs, NGOs).
C: Current situation and future scaling up	

Counties where already promoted if any	Kiambu, Makueni, Machakos in other crop value chains
Counties where TIMPs will be up scaled	All counties suitable for the crop including Western, Nyanza, Rift valley, & Central.
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of potato innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Labour intensity and high cost of herbicides • Inadequate knowledge and information on which herbicides to use, when to use them and their persistence in the soil. • Myths on appropriateness of using herbicides
Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Establish potato innovation platforms • Promotion of the technology/ product in the suitable areas conducting demos and field days and involvement of the stakeholder e.g. agro-chemical companies and agro-dealers • Develop and disseminate information to various stakeholders. • Training on integrated approaches using available methods, including appropriate herbicides for potato, their persistence in different soil environment that can affect follow up crops in the rotation because of residues or carryover to follow up crops during rotation
Lesson learned in up scaling if any	<ul style="list-style-type: none"> • Integrated approaches of weed management are more effective than use of one control method. • Continuous use of herbicides is an environmental, health and social hazard hence the need to follow instructions on the label • 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 need attention.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Train farmers to understand benefits of and how IWM works. • Have an environmental and safety plan when using herbicides. • Address the environmental and social concerns related to use of agrochemicals. • A functional agro-dealer network to supply registered herbicides when required by the farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour for timely IWM KES 5,000 per acre (10 day@ KES 500). Labour reduced from 20 to 10 days. Cost of herbicide per acre is about KES 5,000
Estimated returns	Returns = KES 320,000 per acre (1,600 kg per acre@ KES 200 per kg)
Gender issues and concerns in	<ul style="list-style-type: none"> • Women and youth have limited access to production resources such as land, capital to purchase herbicides

development dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women work is complicated by their multiple roles they do such as such domestic roles • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge on IWM • Women and youth have less access to knowledge and information on IWM • Use of IWM technology can reduce labour from manual weeding and save time for other activities for women and children
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth to generate income from weeding • Women and youth to generate income from agro dealer business • Women and youth to generate income by starting cottage value addition factories due to enhanced yield • There will be improved food security and nutrition from weed free crop for women • There will be increased job security for women and youth by spraying herbicides • There will be increased production since the weed competes with plants leading to low production
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMG groups could have limitations in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes • VMG have less access to extension training as they are not given equal opportunities • VMG have less access to knowledge and information on IWM • VMG have less access to capital to purchase herbicides
VMG related opportunities	<ul style="list-style-type: none"> • VMG to generate income from agro dealer business • VMG to generate income by starting cottage value addition factories due to enhanced yield • There will be increased production leading to increase food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Manuals, brochures, fact sheets on weed management developed by KALRO, MOALD and CABI
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	<ol style="list-style-type: none"> 1. Ready for up scaling 2. Requires validation

G: Contacts	
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Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

2.7.2 Mulching for Weed Management in Potato

Technology name	Mulching for Weed Management in Potato
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Diversity of annual and perennial grass and broadleaved weed species infestation combined with improper weed control measures that lead to low and poor quality yields.
What is it? (TIMP description)	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 include straw, grass and dead leaves. Organic mulches should be between 2-4 inches deep to effectively prevent weed germination and suppress the growth in potato fields. In addition organic mulches retain moisture in the soil; keep the soil cool; and help improve soil fertility and improve microclimate when they decompose. Synthetic mulches will solarize 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 organic 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 enhances the growth and yield of potato. 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	Farmers, Agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release mulching technology in potato varieties • A platform for interaction of potato value chain stakeholders • Availability of plant or crop residues for organic mulches. • Size of the land. • Competing uses of crop residues. • Type and availability of the crop residues • Cost and availability of synthetic materials • Disposal of material after use.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to provide Research services • County governments and MOALD 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	Makueni
Current extent of reach	Available and practiced in different crop value chains in the country
Counties where TIMP will be promoted	Where potato is a priority value chain.
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of potato innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the agronomic practice • Labour intensity and availability of mulching materials • 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. • Be aware of small tears and rips which will allow weeds to emergence through plastic mulches including around the holes. Purple and yellow nutsedge and oxalis may penetrate mulches as early as six days after planting in plastic mulches.

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish potato innovation platforms • Crop diversification to increase availability of organic mulches. • Establish and follow a good integrated weed management control program for the particular potato varieties. • Monitor for any tears /rips and pull out any weeds without allowing them to take over. • Adapting alternative mulching materials like high absorbance polymers.
Lessons learned	<ul style="list-style-type: none"> • 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/ IWM • Availability of market 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 like straws dry leaves, and dry grass. • Mulching is environmentally friendly
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Practice is socially acceptable • 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 of mulch is about KES 4,000 and labour 1,000 per acre (2days@500) to mulch. This reduces weeding labour cost from KES 15,000.
Estimated returns	Dependent on potato varieties mulching increases potato yield by 33%. Returns will be = 133% of KES 320,000 per acre (1,600 kg per acre@ KES 200 per kg) =KES 425,000.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Mulching work is mainly done by women who have any other roles creating more work for them • Women might not be aware that mulching is used as a weed control method • Women have limited access to productive resources such as land so they might not have enough residues to do mulching • The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	<ul style="list-style-type: none"> • There is potential of reduced workload for women • Improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • Though easy to use, it is labour intensive for VMGs, hence its adoption and scaling up is a challenge • VMGs have limited access and control of productive resources such as land

adoption and scaling up	<ul style="list-style-type: none"> • The VMGs have no finances to pay hired labor due to limited access to credit facilities
VMG related opportunities	<ul style="list-style-type: none"> • Mulch is locally available on-farm, and thus has very low costs implying that all including • VMGs can take advantage of the practice • Improves food production and nutrition for VMGs .
E: Case studies/profiles of success stories	
Success stories	<p>Mulching increases potato yield by 33% in dry areas such as Makueni, Narok, Taita Taveta, West Pokot, Kitui and Kajiado</p> <p>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.</p>
Application guidelines for users	Manuals on weeds, fact sheets on weeds
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	<ol style="list-style-type: none"> 1. Ready for upscaling 2. Requires validation
G: Contacts	
Contacts	<p>Centre Director - Food Crops KALRO Kabete, Waiyaki Way Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Dr Violet Momanyi.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) -capacity building and extension • International Potato Centre (CIP) - Collaborative research on potato variety development • Common interest Groups (CIGs) - backstopping the technologies at grass root levels • NGOs (CARE Kenya):(Farmer Input Promotion) - farmer input promotion • USAID FtF (United States Agency for International Agriculture; Feed the Future) - supporting seed and ware potato value chains • County Governments – extension services

2.7.3 Chemical Weed Control in Potato

TIMP Name	Chemical Weed Control in Potato
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High incidence of difficult to control 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 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.
	<div> </div> <div> <p><i>Pre-emergent herbicide application on the soil</i> Source: Hottensiah Mwangi</p> </div> <div> </div> <div> <p><i>Applying herbicide to kill weeds after tillage and prevent seed germination</i> Source: Violet Momanyi</p> </div>
	Some recommended herbicides include: Sencor and Ambar 480 SC @ 50-100mls in 20 liters of water Agil 100EC @ 100-200ml in 20 liters of water to control grass weeds in potato
Justification	Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and weed control is timely. This prevents competition with potato leading to high yields
Region promoted	Technology has been promoted in other crop value chains in Kiambu, Machakos, Kitui.
Counties where TIMP will be upscaled	All the areas where potato is being grown.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies, Agripreneurs

Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Most effective approach	On-farm experimentation and demonstrations on larger plots.
Critical/essential factors for successful promotion	Capacity building and training on safe use of chemicals for all users
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Public and private partners – (MOALD) for extension, • Chemical companies for back stopping • ICRISAT for technical backstopping and promotion; • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	Validation of these herbicides needs to be done before recommendations are given to the farmers.
Challenges in dissemination	<ul style="list-style-type: none"> • Limited knowledge, information and low literacy levels among the farmers. • Herbicide use and application requires knowledge and training on safe and responsible use of herbicides. • The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Establish potato innovation platforms • There is need to train the agricultural extension county officers as TOTs on appropriate use of herbicides. This will help in reaching the farmers with the information. • Herbicides like all chemicals have to be used with care to avoid environmental, health and social hazards. • Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on safe use of herbicides.


Lessons learned	<ul style="list-style-type: none"> • Chances of successful up 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- chemical weed control • Consumers concerns of herbicide residues in the soil and subsequent crops needs attention • Availability of market 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 increase productivity.
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and safe use of chemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour and cost spent weeding is reduced from 5 days (KES 5@500 = 2,500) to nil days per acre because weed will controlled timely. The cost of herbicides per acre is KES 5,000
Estimated returns	Returns = KES 750,000 per acre (15,000 kg per acre@ KES 50 per kg). Estimated financial returns will be high; labour saved; environment conserved
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> • Women and children are the main sources of labour in potato farms • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities. • Women and youth have limited access to productive resources such as credit to buy weed control chemicals • Women and youth have limited access to education, training and extension services and as well as new technologies such as weed control chemicals • Women have less access to agricultural information, technology and knowledge • Men dominate decision making at the household and community levels on types of chemicals to use at the farm level • Women have limited access to information, technology and knowledge on stalk disposal as compared to men • Women have got limited access to funding to purchase the weed chemicals • There is slow information and awareness flow to female farmers due to their low academic levels

Gender related opportunities	<ul style="list-style-type: none"> • The technology would create employment for the youth and women within the potatoes value chain • Youth could form groups and engage in spraying weed using weed control chemicals • The adoption of the TIMP will lead to reduced work for women as it will attract men into engaging into weeding • There will be increased yields and sales leading to improved food and nutrition security
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to productive resources such as land, credit to access fertilizers and farmyard manures. • VMGs have limited access to training and extension services such as chemicals used in weed control • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	<ul style="list-style-type: none"> • Use of herbicides will improve weed management leading to increased productivity • Increase availability of potatoes for consumption which will improve food security hence improved health of VMGs; • Potential for value addition will lead to increased income of VMGs.
E: Case studies/profiles of success stories	
Success stories	In Kiambu, increased potato production and in other crop value chains across the country.
Application guidelines for users	<ul style="list-style-type: none"> • 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 • Weed control leaflets/ manuals from KALRO and CABI
F: Status of TIMP Readiness (1. Ready for up-scaling; 2.Requires validation; 3.Requires Research)	1-Ready for up-scaling
G: Contacts	
Contacts	Centre Director - Food Crops KALRO Kabete, Waiyaki Way Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO Moses Nyongesa., Mbiyu Miriam. Violet Momanyi., Hottensiah Mwangi., Susan Otieno.
Partner organizations	ICRISAT Nairobi; MoALF in Counties , Chemical companies

GAPS:

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

2.7.4 Solarization Bed for Weed Control in Potato

TIMP Name	Solarization Bed for Weed Control in Potato
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)	<p>Solarisation 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 10⁰C 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.</p>  <p><i>Solarization of soil using transparent polythene film.</i> <i>Source: infonet-biovision.org</i></p> <p>The mechanism can increase soil temperature by 8-12 °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 length of period of heating.</p>
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 environmentally friendly method that is sustainable for small scale organic growers. If done properly, the use of post-emergent herbicides to control weeds is not necessary.
Region promoted	None
Counties where TIMP will be upscaled	Solarization bed for weed control can be upscaled in all the areas where potato of high value is being grown especially for organic farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agencies, Agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets, and KTM12 manuals) i.e. Pamphlets • Mass media and Web materials, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and Business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Most effective approach	<ul style="list-style-type: none"> • On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release solarisation bed technology weed control in potato varieties • A platform for interaction of potato value chain stakeholders • Development of the agronomic practice for potato • Capacity building and training on use of polythene and solar power.
Partners/ stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Public and private partners (MOALD) for extension • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Current extent of reach	<ul style="list-style-type: none"> • Validation of solarization needs to be done before recommendations are given to the farmers.
Challenges in dissemination	<ul style="list-style-type: none"> • Few potato innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of recommended agronomic practices • Labour intensity


	<ul style="list-style-type: none"> • 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
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Establish potato innovation platforms • There is need to train the agricultural extension county officers as TOTs on appropriate use of solarization. This help in reaching the farmers with the information • Polythene disposal 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	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value 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 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 potato cultivation and increased 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	<ul style="list-style-type: none"> • 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	Not determined
Estimated returns	Not determined
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> • Women are left out when it comes to formation potatoes innovation platforms to facilitate interaction of farmers with relevant stakeholders • Women are not able to attend organized agricultural trainings and meetings due to their domestic roles and other activities which takes much of their time • Women have limited access to agricultural technologies and information due to their social status in the society

	<ul style="list-style-type: none"> • Limited knowledge and information and low literacy levels among the farmers. • Women have limited finances to purchase the required equipment for the TIMP • Capacity building is required to impart knowledge and skills in appropriate use and application of solarization • The farmers need to understand the proper use and application of solarization to avoid buying inappropriate polythene and minimize health, environmental and social hazards. • Need to sensitize both men and women on value addition of potatoes and losses caused by weed competition
Gender related opportunities	<ul style="list-style-type: none"> • Adoption of technology will reduce the labour burden for women and children. • There will be increased production
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are left out in formation of potato innovation platforms to facilitate interaction of farmers with relevant stakeholders • VMGs are not able to attend organized agricultural trainings and meetings due to financial constraints as they have limited access to credit • Due to prejudice associated with their social status, VMGs are excluded from accessing benefits from improved technologies • Affirmative action is required to promote the solarization for the VMGs and value addition aspects
VMG related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption of potatoes of high nutritive value hence improved health of VMGs • Value addition of potatoes will lead to improved incomes of VMGs
E: Case studies/profiles of success stories	
Success stories	Needs to be promoted in the country
Application guidelines for users	<ul style="list-style-type: none"> • Muhammad A.K.<i>et al.</i>, (2012). An approach to organic weed management. J. Communications soil science and plant analysis.43:1847-60. DOI:10.1080/DOI03624 • Ali El Keblawy 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. • 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 3. Requires further research
G: Contacts	

Contacts	Centre Director - Food Crops KALRO Kabete, Waiyaki Way Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MOALD in Counties, Chemical companies

2.7.5 Safe Use of Herbicides in Potato

TIMP Name	Safe Use of Herbicides in Potato
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 the right 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 recommended practice 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. 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.


	 <p><i>Full protection while spraying is recommended</i> <i>Source: Hottensiah Mwangi</i></p>
Justification	<p>Although cases of improper and misuse use of pesticides are very common in most of the areas where maize is grown, they are not documented. There have been incidences of excessive use, improper handling that leads to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that leads 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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Spray men, Agro-dealers, Agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/ essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive Research to continuously test, validate and employ safe use of herbicide in potato production • A platform for interaction of potato value chain stakeholders • Development of agronomic practices for potato • 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	<ul style="list-style-type: none"> Ministry of Agriculture to provide extension services and farmer trainings, Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for maize 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 technology is already being promoted if any	Promoted in other crop value chains (maize and beans, <i>dolichos</i> , <i>mucuna</i>) in Siaya, Machakos, Makueni, Kiambu Counties.
Counties where TIMPS will be up scaled	Regions where potato is grown for subsistence and commercial uses.
Challenges in dissemination	<ul style="list-style-type: none"> Lack of potato 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	<ul style="list-style-type: none"> Establish potato 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 pesticide containers Establishment of training of Extension staff and lead farmers as TOTs
Lessons learned in upscaling if any	<ul style="list-style-type: none"> 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 helps 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 Consumers concerns of herbicide residues in the soil and subsequent crops needs attention Upscaling of this technology needs young men due to its hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collection and incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups

	<ul style="list-style-type: none"> • Low literacy 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	Organized collective marketing channels are critical for benefits to be derived from practice.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of protective equipment is, about KES 3,000. They can be used for more than 3 years before replacement
Estimated returns	Use of the right rate of herbicides will effectively control weeds which will increase yields and returns by about 20% of (15,000 kg @ KES 50) = KES 900,000/ per acre depending on market price and variety.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Technology is not safe for use by expectant women and the physically challenged individuals because of associated risks/ toxic nature • Herbicides and protective gear are expensive and most women may not afford them • Lack of knowledge by men and women on the dangers of herbicides especially on storage and disposal • Low levels of literacy and inability to read and interpret the content on labels especially on re-entry period after spraying, rate and Pre Harvest Interval (PHI). This leads to poisoning of the worker and high residue levels in the crop which is a health concern • Women and youth have limited access to productive resources such as credit to purchase weed control chemicals and protective gear • Women and youth have limited access to education, training and extension services and on new technologies such as weed control chemicals • Men dominate most decisions at the household and community levels on types of chemicals to be used in potato farms • Women have limited access to information, technology and knowledge on the type of chemicals to be used for weed control in the potato farms
Gender related opportunities	<ul style="list-style-type: none"> • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities • Formation of spray teams by young men hence creating employment for the youth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • These are dangerous products that may not be handled safely by vulnerable groups • Herbicides are expensive for VMGs to afford • VMGs have limited access to productive resources such as land, credit to access farm inputs such as herbicides • VMGs have limited access to training and extension services such as chemicals used in weed control

	<ul style="list-style-type: none"> • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to their status to purchase weed control chemicals
VMG related opportunities	<ul style="list-style-type: none"> • Safe use of herbicide can easily be undertaken by the VMGs as establishing employment for herbicide spray teams in the wards in each county and they charge for services provided • VMGs have the potential of operating agro-vets to stock farm inputs such as herbicides, pesticides, fertilizers among others • The use of weed control chemicals contributes to reduced labor burden for VMGs
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • 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 MOALD
Application guidelines for users	Pest decision guidelines, manuals, fact sheets, brochures developed by KALRO and CABI.
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	1-Ready for upscaling
F: Contacts	
Contacts	Centre Director - Food Crops KALRO Kabete, Waiyaki Way Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO Moses Nyongesa., Mbiyu Miriam., Violet Momanyi, Dr Hottensiah Mwangi., Susan Otieno
Partner organizations	MOALD, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

2.7.6 Mechanical Weed Control in Potato

TIMP Name	Mechanical Weed Control in Potato
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	A variety of annual and perennial grass and broadleaved weed species infestation and poor control methods in potato crop leading to low and poor quality yield.
What is it? (TIMP description)	<p>Mechanical/ manual weed control is a technique that manages weed populations through physical methods that remove, injure, kill, or make the growing conditions unfavourable for growth using tools such as pangas, jembes and slashers. Land preparation is done manually using hoes or implements such as sub-soilers. Some of the methods cause direct damage to the weeds through complete removal or causing a lethal injury. Other techniques may alter the growing environment by eliminating light, increasing the temperature of the soil, or depriving the plant of carbon dioxide or oxygen. Mechanical control can be either selective or non-selective. A selective method has very 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.</p> <div>  </div> <p>1. Sub-soiler for land tillage 2. Clean seed bed prepared manually</p> <p>Source: Hottensiah Mwangi</p> <p>Delay in weeding which may result into weed take over resulting in severe competition with the potato should be avoided. The right tools for weeding are used to avoid shock-stress on potato due to disturbance and root damage</p>

	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 yield losses. Deep tilling maximizes soil disturbance 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. Tilling mechanically increases the chances of weed seed 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 then be destroyed by mechanical tillage before planting or weeding after planting to get a clean crop that will give good yields.
Region promoted	ASAL regions, Busia, Kakamega. Generally, this is the method used for many years across the country.
Counties where TIMP will be upscaled	All counties growing potato.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Agripreneurs and Agricultural extension officers.
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Most effective approach	On-farm experimentation and demonstrations on large plots.
Critical/ essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release improved mechanical weeding in potato varieties such as implements for minimum tillage. • A platform for interaction of potato value chain stakeholders • Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Public and private partners including MOALD for extension • KALRO for research service • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing, and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	

Current extent of reach	Limited research done on gender responsive weeding using modified implements especially for VMG.
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of potato innovation platforms to facilitate interaction of farmers with relevant stakeholders • Labour intensity • Low use of agronomic practices • Labour intensity • Appropriate implements such as sub-soilers are not readily available in the market.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish potato innovation platforms • Work with Jua Kali industries for fabrication of appropriate implements such as sub-soilers.
Lessons learned	<ul style="list-style-type: none"> • 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 weeding tools (technology) will provide timely weed control with reduced drudgery to enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the mechanical weed management practices for sensitive potato young plants.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic costs include tilling, weeding, seeds and hiring sub-soiler implement which is approximately 8,000 per acre. This reduces costs from KES 15,000 to about KES 8,000. A sub-soiler takes less than a day to till land compared to 10 days or more when done using a hoe
Estimated returns	Dependent on potato varieties preparing and planting in a clean weed free seed bed will increase yield and thus returns by about 10% of (15,000kg @ KES 50) per acre = KES 825,000 depending on market price and variety.
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> • Mechanical weeding is gender is a laborious activity for all genders • Mechanical weeding in potato farms increases workload for women who are already burdened by their domestic roles • Women and youth have limited finances to pay labor services and to purchase farm equipment due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in potato farms • Women and youth have limited access and control of production resources such as land, credit to purchase farm equipment • There is need to equip women, youth and stakeholders with information relating to mechanical weed control method

	<ul style="list-style-type: none"> There is also need to sensitize all genders on the losses caused by weeds and the importance of timely weed control.
Gender related opportunities	Timely weeding will lead to increased potatoes production
VMG issues and concerns in development , dissemination adoption and scaling up	<ul style="list-style-type: none"> Mechanical weeding is not friendly for VMGs to perform as it is labour intensive VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in	<ul style="list-style-type: none"> Increased production will improve food security and nutrition for VMGs If adopted the VMGs will get employment at various nodes of potato value chains There is potential for increased incomes for VMGs
VMG related opportunities	<ul style="list-style-type: none"> Increased production will improve food and nutrition security and economic empowerment of VMGs Reduction of labour will enable women and children will get involved in other gainful activities.
E: Case studies/profiles of success stories	
Success stories	Tharaka Nithi
Application guidelines for users	ToT Manuals to include KALRO weed management TIMPs. Manuals, pamphlets, brochures, fact sheets from KALRO and CABI
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 - Food Crops KALRO Kabete, Waiyaki Way Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MOALD in Counties, Potato breeders

2.8 Potato Post-harvest TIMPs

2.8.1 Dehaulming

TIMP Name	Dahaulming
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Reduced harvesting efficiency and storage life of ware potato.
What is it? (TIMP description)	This is the removal or destruction of the haulm (the plant above the ground level) to allow the skin to harden and reduce damage to the tubers during harvest. This is usually done 10 to 14 days before harvesting and improves the storability of the tubers. The haulms can be removed manually with a <i>panga</i> or mechanically with a rotary mower.
Justification	Dehaulming improves efficiency of harvesting, especially if harvesting is mechanized. It also improves the storability of the roots.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and traders
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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

	<ul style="list-style-type: none"> • CIGs (Common Interest Groups)- backstopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): farmer input promotion • USAID FtF (United States Agency for International Development- Feed the Future) – supporting seed and ware potato value chains
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties -Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho) • Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi
Counties where TIMP will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on the TIMPs • Lack of incentives for producing quality tubers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation about the TIMP to farmers • Availing data on economics and the gains to be made through adoption of the TIMP • Providing incentives for producing and selling quality potato tubers
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There will be a reduction in chemical residue exposure due to injury of tubers during harvesting • 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
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Willingness of farmers to adopt the technology • Favourable policy to support uptake of the practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women might not be aware of the technology due to limited access to agricultural information and technology • The activity is labor intensive adding more work to women who are already burdened by other domestic activities

	<ul style="list-style-type: none"> • The innovation requires keen observation and knowledge of crop maturity which may be a challenge to both men and women • Women have limited resources to hire labor due to limited access to credit facilities
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for increased returns due to appropriate harvesting techniques • Women will benefit by accessing better quality products to sell in the market
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The activity is labor intensive for the VMGs to perform • VMGs might not be aware of the TIMP due to limited access to agricultural information and extension • VMGs have limited resources to hire labor due to limited access to credit facilities
VMG related opportunities	<ul style="list-style-type: none"> • The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture into commercial production of potatoes • There will be increased food security and nutrition for the youth
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	NPCK, Potato Handbook
F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	<p>Centre Director KALRO Tigoni - Potato Research Centre P.O. BOX 338-00217, Limuru Telephone: 0202023213 Mobile: 0727031783 Email: kalro.tigoni@kalro.org www.kalro.org</p>
Lead organization and scientists	<p>KALRO – Tigoni Judy Oyoo, Moses Nyongesa, Miriam Mbiyu, Susan Otieno, Francis Wayua, James Ndambuki, Charity Gathambiri</p>
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK)

	<ul style="list-style-type: none"> • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture-Feed the Future) • County governments – Extension services • USAID Ftf (United States Agency for International Development-Feed the Future)
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2.8.2 Maturity Indices and Correct Time for Harvesting Potatoes

Technology Name	Maturity Indices and Correct Time for Harvesting Potatoes
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)	<p>This is a management practice involving careful maturity indices, pre-harvest operations and actual harvesting procedure.</p> <p>Maturity indices and correct time for harvesting Potato are harvested when they attain sufficient size (2 to 3 inches in diameter) – early varieties 57-100 days, late varieties 120-160 days Skin slipping from the tuber, starch content and leaf senescence or top drying</p> <p>Harvesting Harvesting can be done manually and mechanized.</p> <p>Manual harvesting Manual harvesting involves uprooting / lifting the tubers by using hand-held hoes, fork <i>jembes</i> or 2-pronged sticks after the haulms are completely dry. Using sticks or fork <i>jembes</i> dig out any tubes that could be stuck in the ground along the ridges or furrows. After harvest ensure the soil on the tuber is dry before transporting the tubers to the store because soil could spread diseases or pests in the store later. Also soil restricts the movement of oxygen through the pile, inducing anaerobic conditions and consequent tuber rotting.</p>



*Harvesting of potato
(Source: Judith Oyoo)*

Mechanical harvesting

For mechanized harvesting, see TIMPs under mechanization.

Regardless of the harvesting method, care must be taken to avoid cutting, skinning or bruising of the tubers. Mechanical damage during harvest can become a serious problem, as injuries predispose the tubers to bacterial and fungal pathogens (that cause decay), increased water loss and respiration leading to quick deterioration.

Justification

Incorrect timing of harvesting and inappropriate harvesting methods leads to losses of potatoes. Harvesting before the maturity of the crop means the tubers will not be fully developed. Younger tubers have softer skins and are more susceptible to damage at harvest. Delayed harvesting results in tubers that will become fibrous and attacked by weevils, rats and moles while in the ground, particularly if the soil dried out and cracked, providing easy entry places for weevils and root rots.

B: Assessment of dissemination and scaling up/out approaches

Users of TIMP

Potato farmers, traders, processors,

Approaches used in dissemination

- Demo plots
- Exhibition, Agricultural Shows
- Use of digital platforms
- Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets
- Mass media and Web material's, Mobile Apps and SMS, Digital platforms
- Regular localized meetings
- Farmer field and business Schools (FFBS)
- Public and private agricultural extension services
- Agricultural Innovation Platforms (AIP)

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Existence of effective extension services to demonstrate the technology • Increased production of high quality potatoes
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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)- backstopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): farmer input promotion • USAID FtF (United States Agency for International Development- Feed the Future) – supporting seed and ware potato value chains
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties -Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho) • Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on maturity and appropriate harvesting technology • Negative attitude by farmers towards adoption of new agricultural TIMPs
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation about the TIMP to farmers • Capacity building of farmers on the TIMP • Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP - Partnership is important in technology dissemination • Consistent trainings, demonstrations and sensitisation would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Willingness of farmers to adopt the technology • Market able to absorb increased supply of quality potato • There will be favourable policy for adoption of potato

for development and upscaling	
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour for harvesting
Estimated returns	Not yet estimated
Gender issues and concerns in development dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Harvesting potatoes is a laborious activity for all genders and it increases workload for women who are already burdened by their domestic roles • Women and youth have limited finances to pay labor services due to limited access to credit facilities • The innovation requires keen observation and knowledge of crop maturity which may be a challenge to both men and women
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for increased returns due to appropriate harvesting techniques • Women will benefit by accessing better products to sell in the market • There will be increased employment for the youth
VMG issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • increases workload for VMGs • VMGs have limited finances to pay labor services due to limited access to credit facilities • The innovation requires keen observation and knowledge of crop maturity which may be a challenge to the VMGs
VMG related opportunities	<ul style="list-style-type: none"> • The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • Opportunities are more for youth to acquire the skill
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Application guidelines for users	Gumbo, N., Magwaza, L. and Ngobese, N. (2021). Evaluating ecologically acceptable sprout suppressants for enhancing dormancy and potato storability: a review. <i>Plants</i> , 10, 2307. https://doi.org/10.3390/plants10112307
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	2- Requires validation
F: Contacts	
Contacts	Centre Director KALRO Tigoni - Potato Research Centre

	P.O. BOX 338-00217, Limuru Telephone: 0202023213 Mobile: 0727031783 Email: kalro.tigoni@kalro.org www.kalro.org
Lead organization and scientists	KALRO-Tigoni: Judy Oyoo, Moses Nyongesa, Susan Otieno, Miriam Mbiyu, Francis Wayua, James Ndambuki, Charity Gathambiri
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments • USAID Ftf (United States Agency for International Development- Feed the Future)

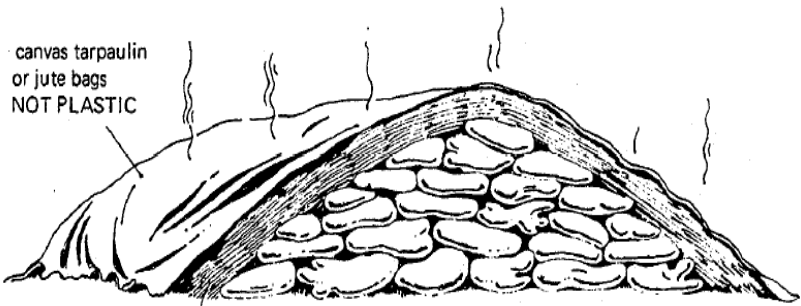
GAPS

Quantification of the losses due to incorrect timing of the right maturity for harvesting different potato varieties.

2.8.3 Curing for Storage of Ware Potatoes

Technology Name	Curing for Storage of Ware Potatoes
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest disease infestation during storage of ware potatoes
What is it? (TIMP description)	This involves exposing the harvested potato tubers immediately (within 1 to 2 hours) following harvest, to moderate temperatures of 25-30°C and high relative humidity (85-95%) for 10 to 14 days. Tubers should never be washed prior to curing and/or storage, as this would result in severe decay after several weeks. Curing should be started within 1 to 2 hours of harvest. The temperature should not exceed 35°C nor should the relative humidity be so high (i.e. 100%) where moisture condensation occurs on the surface of the potato. Curing toughens the skin in order to protect them from damage, and heal any existing wounds, thus reducing the risk of postharvest diseases

infestation. Curing can be done in two methods – (a) field curing, and (b) curing using ventilated sheds. After curing, sort the potatoes and discard those that are soft or discolored.



At least 6" (15 cm) depth of cut grass placed on top of yams.

Field curing

(Source: Kitinoja and Kader, 2003)



Curing potatoes using ventilated sheds

(Source: Francis Wayua)

Justification

Curing enables tubers to be stored to provide food for a longer period and expand marketing opportunities. Curing has the following benefits:

- Protects harvested tubers against diseases. Curing heals the wounds on and in the skin (caused during harvesting and handling) by the formation of new skin tissue and toughening of the skin of the tubers. This helps protect the tubers from damage and reduces the risk of postharvest disease infection
- Reduces shrinkage of tubers (reduce moisture loss during storage)
- Develops taste and flavour by converting starch to sugars
- Improves visual appeal and eating quality of the tubers

	<ul style="list-style-type: none"> • Extends the storage life of tubers. Cured roots can be stored for several months
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers, traders, processors,
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Existence of effective extension services to demonstrate the technology • Increased production of high quality potatoes
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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)- backstopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): farmer input promotion • USAID FtF (United States Agency for International Development- Feed the Future) – supporting seed and ware potato value chains
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties -Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho) • Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu


Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on the TIMPs • Lack of incentives for producing quality tubers
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation about the TIMP to farmers • Availing data on economics and the gains to be made through adoption of the TIMP • Providing incentives for producing and selling quality potato tubers
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination • Consistent training and demonstrations will motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Willingness of farmers to adopt the technology • Market able to absorb increased supply of quality potato • There will be favourable policy for adoption of potato • Policy incentives for farmers and traders having high quality potatoes
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour for curing, cost of constructing curing sheds
Estimated returns	Reduced storage losses, extended shelf-life, high income and nutrition
Gender issues and concerns in development dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Curing potatoes is a labor intensive activity and it increases workload for women who are already burdened by their domestic roles • Women and youth have limited finances to pay labor services due to limited access to credit facilities • Women and youth have no access to productive resources such as land, credits and farm equipment so they might not be in a position to construct ventilated sheds for curing potatoes • The technology is easily applicable hence all genders can learn it easily
Gender related opportunities	<ul style="list-style-type: none"> • It is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during storage • It creates employment for women and the youth .
VMG issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Curing potatoes is a labor intensive activity for VMGs to undertake • VMGs have limited finances to pay labor services due to limited access to credit facilities • The technology is easily applicable hence all genders can learn it easily
VMG related opportunities	<ul style="list-style-type: none"> • The technology will create jobs hence source of income for VMGs • The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • There will be prolonged shelf life for potatoes leading to improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Application guidelines for users	Gumbo, N., Magwaza, L. and Ngobese, N. (2021). Evaluating ecologically acceptable sprout suppressants for enhancing dormancy and potato storability: a review. <i>Plants</i> , 10, 2307. https://doi.org/10.3390/plants10112307
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni: Judy Oyoo, Moses Nyongesa, Susan Otieno, Miriam Mbiyu, Francis Wayua, James Ndambuki, Charity Gathambiri
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments • USAID Ftf (United States Agency for International Development- Feed the Future)

2.8.4 Sorting and Grading

Technology name	Sorting and Grading
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	

<p>Problem to be addressed</p>	<p>Poor quality due to mixing of good quality and poor quality potato tubers during harvesting.</p>
<p>What is it? (TIMP description)</p>	<p>Sorting is done to remove rotten, damaged (bruised, cut), malformed and weevil-infested roots, and debris from the good ones. All potatoes showing greening decay or severe damage owing to harvesting or pest attack should be discarded at harvest. Immature tubers and those showing minor damage or wetted by rain should be put aside for immediate consumption. Potatoes to be stored for food, or seed should be fully mature and free from any visible damage or decay.</p>  <p><i>Sorting of potatoes</i> (Source: Judith Oyoo)</p> <p>Grading classifies potato tubers by size and simplifies product selection for market sellers. Grading should be carried out to separate the ware, seed and chats. Each bag should be well-labelled according to variety description and weight for ease of identification. Grading can be done <i>manually</i> or with <i>mechanized graders</i>.</p>  <p><i>Grading of sorted potato</i> (Source: Judith Oyoo)</p>

Justification	<p>Sorting removes rotten potatoes, insect damaged potatoes and mechanically damaged potatoes to discourage infestation by Potato Tuber Moth (PTM) and rotting in the case of mechanically damaged tubers. Sorting gives a higher quality and appealing product for the market.</p> <p>Grading facilitates marketing of potatoes since the seller and buyer can more easily agree on the price based on the size of the tuber; ensures fairness in marketing since prices are determined by the size of the tuber; and facilitates buyers to select potatoes based on what they will use them for, e.g., processing into crisps, baking, roasting or consumption at restaurants.</p>  <p><i>Mechanised grader for potato</i> (Source: Judith Oyoo)</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers, agripreneurs, traders, exporters, processors
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Existence of effective extension services to demonstrate the technology • Increased production of high quality potatoes
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • CIP (International Potato Centre) – Collaborative research on potato variety development • 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

	<ul style="list-style-type: none"> • CIGs (Common Interest Groups)- backstopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): farmer input promotion • USAID FtF (United States Agency for International Development- Feed the Future) – supporting seed and ware potato value chains
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties -Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho) • Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi
Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on the TIMPs • High cost of mechanized graders
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation about the TIMP to farmers • Availing data on economics and the gains to be made through adoption of the TIMP • Providing incentives for producing and selling quality potato tubers • Availing credit facilities to procure mechanized graders
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Willingness of farmers to adopt the technology • Market able to absorb increased supply of quality potato • There will be favourable policy for adoption of potato • Policy incentives for farmers and traders having high quality potatoes
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour for harvesting
Estimated returns	Not yet estimated
Gender issues and concerns in development dissemination, adoption and upscaling	<p>Sorting and Grading potatoes is usually done by women increasing their labor. It is easily adoptable after training and many farmers can use the technology since it reduces losses incurred after harvesting and increases income.</p> <p>Women have no finances to pay for hired labor due to limited access to credit facilities</p>

	Women and do most of the work within the potato value chain but the funds are controlled by men hence they have no funds to pay the workers The management practice are easily applicable hence farmers can easily learn them.
Gender related opportunities	<ul style="list-style-type: none"> • There is reduced potato post- harvest losses • Creates employment for the youth • Increases income for women ad youth
VMG issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Sorting and grading of potatoes is a labor intensive activity for some VMGs to undertake • VMGs have limited finances to pay labor services due to limited access to credit facilities
VMG related opportunities	<ul style="list-style-type: none"> • The technology will create jobs hence source of income for VMGs • The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • There improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Application guidelines for users	Gumbo, N., Magwaza, L. and Ngobese, N. (2021). Evaluating ecologically acceptable sprout suppressants for enhancing dormancy and potato storability: a review. <i>Plants</i> , 10, 2307. https://doi.org/10.3390/plants10112307
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	1-Ready for up-scaling
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni: Judy Oyoo, Moses Nyongesa, Susan Otieno, Mbiyu Miriam, Francis Wayua, James Ndambuki, Charity Gathambiri
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization)

	<ul style="list-style-type: none"> • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments • USAID Ftf (United States Agency for International Development- Feed the Future)
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2.8.5 Ambient/Naturally Ventilated Ware Potato Store

Technology name	Ambient/Naturally Ventilated Ware Potato Store
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 inappropriate ware potato storage. Low household incomes as a result of glut in the market as farmers sell off potatoes quickly during peak production since they cannot store them
What is it? (TIMP description)	<p>This is a store constructed of locally available material for storage of ware potato. It provides temperatures of 4–8°C and can allow up to 8 months of storage. Store in <i>cool, dark and well</i> ventilated areas.</p>  <p><i>Naturally ventilated ware potato store</i> (Source: Oyoo, J. O.)</p>
Justification	Ware potato storage leads to prolonged shelf life hence contributing to steady supply of potatoes to the market even during offseason production. Storage increases household incomes since if potatoes can be stored just for a month or more after production, market prices improve significantly leading to increased household incomes of potato growers by up to 100%.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers, small scale potato growers and SMEs, research organizations/institutions (universities), processors (Deeper Industries Ltd; Propac Ltd, Sereni Fries Ltd, Twiga foods)
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Existence of effective extension services to demonstrate the technology • Accessibility and cost of the Ware Storage Technologies to farmers and traders • Funding to promote the ware potato stores
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development - Extension and Capacity Building • CIP (International Potato Centre) – Collaborative research on potato variety development • 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)- backstopping the technologies at grass root levels • GIZ- Nutrition and potato utilization by the communities • NGOs (Non-governmental organization) (CARE Kenya): farmer input promotion • USAID FtF (United States Agency for International Development- Feed the Future) – supporting seed and ware potato value chains
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties -Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho) • Emerging potato producing counties in mid-altitude AEZ -Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi

Counties where TIMP will be up-scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Big challenge between information availability and accessibility • Non-exposure of the end-user to Ware Storage
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on Ware Store • Scaling up participation of end-users in on-farm activities/adaptive research/extension activities • Promotion in potato growing areas • Seed potato multiplication
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination • Capacity building for the VMGs in agri-business will ensure aggregation of potatoes
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Nutrition education on importance of potato in the local diet • There is availability of market: domestic and regional • Ware potato tubers should be kept in a dark store to prevent greening. The store should be cool and well ventilated • Favourable policy, encouraging better prices for high quality potato
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined
Gender issues and concerns in development dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Ambient/naturally ventilated ware potato store requires accessibility of the construction material which might not be possible for women who have limited access to productive resources such as land, credit facilities and raw materials for construction • Women and youth have limited finances to pay labor services due to limited access to credit facilities • The decision of constructing stores for storing potatoes is usually made by men for the married women
Gender related opportunities	<ul style="list-style-type: none"> • Ware potato storage leads to prolonged shelf life hence contributing to steady supply of potatoes to the market even during offseason production • Storage increases household incomes since if potatoes can be stored just for a month or more after production, market prices improve significantly leading to increased household incomes of potato for women by up to 100%
VMG issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • The VMGs have limited access to productive resources such as land so they might not have a place of constructing potato ware houses • VMGs are poor due to limited access to credit facilities hence they cannot be able to construct ware houses for potatoes

VMG related opportunities	<ul style="list-style-type: none"> • The technology will create jobs hence source of income • The improved productivity will motivate the VMGs to venture in the commercial production of potatoes • There will be increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Application guidelines for users	Oyoo, J.O., Ng'ang'a, N.M., Nyongesa, M.W., Otieno, S., Pwaipwai, P, Mbiyu, M, Esilaba, A.O., Nyongesa, D., Muriuki.J.P., Nasirembe, W and Sila, M. (2021). Simple Ware Potato Storage Structure. KCEP-CRAL Plus Programme, managed by International Fund for the Agricultural Development (IFAD)
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	2-Requires validation
F: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Judy Oyoo, Moses Nyongesa, Francis Wayua, James Ndambuki, Charity Gathambiri
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments • USAID Ftf (United States Agency for International Development- Feed the Future)

2.9 TIMPS on Value Addition of Potato

2.9.1 Potato flour


TIMP Name	Potato flour
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	High perishability of potato and limited utilization
What is it? (TIMP description)	<p>This is flour prepared by milling dry potato chips</p> <div> </div> <p><i>Packages of Potato Flour (Source: Well.ca)</i></p>
Justification	<p>Potato tubers are highly perishable and difficult to store for prolonged period. They are mostly utilized in its roasted or boiled form. Adding value to potato tubers provides a wide range of products, thus increasing market opportunities. Processing potato into high quality flour provides opportunities for income generation and employment. Food security will be improved through loss reduction and making food available throughout the year. Farm surpluses and damaged tubers unsuitable for sale as fresh produce will not go into waste. Bulkiness will be reduced, thus reducing transport and storage costs. Processing potato into flour will lead to improved potato quality in terms of taste, color, flavor and nutritional value. The potato flour can be blended with other flours and diverse value added products made.to improve consumer acceptability</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, processors, agripreneurs, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets

	<ul style="list-style-type: none"> • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality ware potato
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Agricultural extension and advisory services will offer technical advisory services to the farmers • Counties facilitate the extension staff and provide grants to the farmers • CIGs play the role of adoption of the technologies through their various groups • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies
C: Current situation and future scaling up	
Counties where already promoted, if any	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho.
Counties where TIMPs will be up scaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Awareness creation about the product to farmers, traders and other value chain actors • Capacity building of farmers on how to make potato flour • 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 potato • Working with KEBS to develop standards for potato flour
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • It would be good for farmer tours to processing groups to expose farmers to potato flour production technology • Adequate capacity building is essential for technology adoption • Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Regulatory bodies e.g. KEBS available to ensure that processors are certified; and develop standards for potato flour Changing consumer behaviour to incorporate potato flour Existing and new markets are developed and maintained Policies on composite flours are developed and / or implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not established
Estimated returns	Not established
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> Women had limited markets to sell potato products due to limited mobility and exposure Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending and for milling Women, men and the youth should participate in technology demonstrations Processing is mainly done by women and it is involving the youth and men will reduce drudgery for women
Gender related opportunities	<ul style="list-style-type: none"> Women and youth stand to benefit in production, use and sale of potato flour There will be improvement in food security and nutrition for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs might not be aware of potatoes flour due to limited access to agricultural information and extension services VMGs have no finances to purchase equipment for value addition of potato due to limited access to credit facilities
VMG related opportunities	<ul style="list-style-type: none"> There will be employment for VMGs in processing and selling of the diversified products The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS Nutritious products can be made from potato flour contributing to the nutrition of VMGs.
E: Case studies/profiles of success stories	
Success stories	Youth groups processing potato flour in potato growing areas
Application guidelines for users	Kabira, J. N. and Imungi, J. 91991). Possibility of incorporating potato flour into three traditional Kenyan foods. <i>African Study Monographs</i> , 12 (4)211-217.
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 -Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783

	E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO -Tigoni: Ndambuki J., Francis Wayua and Harun Odhiambo
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.9.2 Production of Potato Starch


Technology name	Production of Potato starch
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses of potato during periods of oversupply
What is it? (TIMP description)	<p>Potato starch is a carbohydrate extracted from starch grains of potato tubers. It is used in making soups, gluten free recipes, cakes and cuisines. Some potato starch is also produced as a byproduct from the potato processing industry, recovered from the potato cutting circuit during the production of French fries and potato chips.</p>  <p>Potato starch (Source: https://www.lacademie.com/potato-starch-vs-cornstarch/)</p>
Justification	Manufacturing of cassava potato starch is one way of diversified use of potato, and this will lead to increased demand for the potato, which will trigger increased commercial production and increased certified seed demand.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers, SMEs, processors, agripreneurs, research organisations

Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of inputs • Well organized farmer groups • Value addition trainers • Funding to invest in potato starch extraction
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments • USAID Ftf (United States Agency for International Development- Feed the Future)
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Traditional potato producing counties-Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii, Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho • Emerging potato producing counties in mid-altitude AEZ (Samburu, Trans Nzoia, Makueni, Embu, Tharaka Nithi, Machakos, Kajiado, and Nairobi)
Counties where TIMP will be up-scaled	All counties producing potato
Challenges in dissemination	<ul style="list-style-type: none"> • Limited awareness of the technology by value chain actors • Lack of funds to invest in potato starch processing
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Capacity building of value chain actors on potato starch extraction • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Linkage to credit facility providers to promote commercialization
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Strong PPP-Partnership is important in technology dissemination • Continuous capacity building of farmers, extension officers and other stakeholders enhances adoption

Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> • Important in the local diet • Environmentally friendly resilient and climate smart. • Existing and new markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not established
Estimated returns	Not established
Gender issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Potatoes stakeholder might not be aware of Potato starch due to limited access agricultural information and extension services • Potato starch is expensive to process especially for women who have no finances due to limited access to credit facilities • Land ownership mainly by men and therefore women are not involved in decision making on potatoes value addition • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Potato production is done by youth and women but marketing is done by the men so the money goes to the men
Gender related opportunities	<ul style="list-style-type: none"> • Potato has the potential to create employment for women and youth in production of starch and marketing • There will be prolonged shelf life for potatoes leading to improved food security and nutrition for households
VMG issues and concerns in development, dissemination, adoption and upscaling	<ul style="list-style-type: none"> • Lack of participation by all VMGS hence they might not be aware of the new potatoes products such as potato starch • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hindering them from adopting the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	KALRO Tigoni has developed and optimized a starch extraction protocol
Application guidelines for users	KALRO Tigoni has developed and optimized a starch extraction protocol
F: Status of TIMP readiness (1-ready for	2-Requires validation

up-scaling; 2-requires validation; 3-requires further research	
F: Contacts	
Contacts	Centre Director, KALRO -Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture and Livestock Development (MOALD) • National Potato Council of Kenya (NPCK) • FAO (Food and Agriculture Organization) • Common Interest Groups (CIGs) • Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) • USAID FtF (United States Agency for International Agriculture- Feed the Future) • County governments

2.9.3 Potato Crisps


TIMP Name	Potato Crisps
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited potato food products; high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	<p>Potato crisps are thin slices of potatoes that may have been deep fried or baked until they become crunchy. Fresh potato tubers are cut into thin slices, deep fried in heated cooking oil to a crunchy texture, cooled and package in airtight containers.</p>  <p><i>Potato crisps</i></p>

Justification	Processing of potato tubers into crisps will enhance consumption of potato, enhance demand and thus encourage increased production. Farm surpluses and damaged tubers unsuitable for sale as fresh produce will not go into waste.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, agripreneurs, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high-quality potato products, availability of quality standards • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potato crisps • The government should facilitate affordable credit to empower farmers take up potato agribusiness
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement
C: Current situation and future scaling up	
Counties where already promoted, if any	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Counties where TIMPs will be upscaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • Limited awareness of product by farmers and consumers; limited processing technology at the household level.

	<ul style="list-style-type: none"> • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • It would be good for farmer tours to processing groups to expose farmers to potato flour production technology • Adequate capacity building is essential for technology adoption • Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Regulatory bodies e.g. KEBS ensure processors are certified; and develop standards for potato crisps • Changing consumer behaviour to incorporate potato products • Existing and new markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Potatoes stakeholder might not have the necessary skills to make potato crisps due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make potato crisps due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato crisps is labor intensive hence increase labor for women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato crisps. • There will be improvement in food security and nutrition for women and youth

VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing potatoes skills due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Potato Recipe Book https://www.mipotato.com/sites/default/files/2021-04/Recipe%20Booklet%20Final.pdf

2.9.4 Potato Chips/Fries


TIMP Name	Potato chips/fries
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited potato utilization food products; high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	<p>Potatoes are peeled then cut into chips, deep fried and served hot</p>  <p><i>Potato chips</i></p>

Justification	Potato utilization is limited to boiling and roasting. Diversification of potato tubers will enhance consumption of potato, enhance demand and thus encourage increased production. Adding value to potato tubers will also minimize wastage of farm surpluses and damaged tubers unsuitable for sale as fresh produce. The potato tubers can be processed into chips for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, agripreneurs, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high-quality potato products, availability of quality standards; • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potatoes into various products; the government should facilitate affordable credit to empower farmers take up potato agribusiness.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement
C: Current situation and future scaling up	
Counties where already promoted, if any	The technology has been adopted by farmers in potato growing counties of Kenya - Nyandarua, Nyeri, Kiambu, Taita Taveta, Nakuru, Bomet, Narok, Elgeyo Marakwet, Uasin Gishu, Bungoma, West Pokot, Nandi, Kisii; Murang'a, Baringo, Nyamira, Kirinyaga, Laikipia, and Kericho
Counties where TIMPs will be up scaled	All counties producing potato

Challenges in development and dissemination	<ul style="list-style-type: none"> • 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 potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • A good value-added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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 potato agribusiness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Potatoes stakeholder might not have the necessary skills to make potato chips due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make potato chips due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato chips is labor intensive hence increase labor form women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato chips . • There will be improvement in food security and nutrition for women and youth
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure

	<ul style="list-style-type: none"> • Lack of participation by all VMGS hence they might not have skills and knowledge of processing potatoes skills due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Potato crisps production leaflets and manuals
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 -Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Wayua F., Ndambuki J. and Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling

2.9.5 Potato/Wheat Chapati


TIMP Name	Potato/wheat chapati
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of potato tubers
What is it? (TIMP description)	<p>Potato are washed, peeled, boiled and mash well without plump. The smashed potato is then mixed with wheat flour, cumin powder, salt to taste and warm water to make a dough. Small 2 inch balls are made and flatten. Cooking oil is then gently heated in a pan then the flatten dough are added until it they cook (turns golden brown with some dark areas) both side and served.</p>  <p><i>Potato chapati</i></p>
Justification	Blending potato with wheat flour will reduce the cost of chapatti and diversify the use of potato. This will create demand for increased potato production for enhanced food security and income generation. It will also save on money used to import wheat
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, agripreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potato tubers, availability of quality standards. • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potatoes into

	various products; the government should facilitate affordable credit to empower farmers take up potato agribusiness.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • Processors – processing • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – preparing and/or buying potato chapattis.
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • 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 potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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 potato agribusiness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined

Gender issues and concerns in development and dissemination, adoption and scaling up	<p>Potato stakeholder might not be aware that potatoes can be blended with wheat to make potato/wheat chapatti</p> <ul style="list-style-type: none"> • Women might not have the necessary skills to make potato/wheat chapatis due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make potato/wheat chapatis due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato/wheat chapatis is labor intensive hence increase labor form women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato/wheat chapatis • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for potatoes
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing potatoes skills due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	<ul style="list-style-type: none"> • Potato/wheat chapatti recipe booklets, leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up	1-Ready for up-scaling

scaling; 2. Requires validation; 3. Requires further research)	
G: Contacts	
Contacts	Centre Director, KALRO -Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Wayua F., Ndambuki J. and Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.9.6 Potato Mandazi


TIMP Name	Potato Mandazi
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of potato tubers
What is it? (TIMP description)	<p>Potato/wheat mandazi made from composite flour of 25% potato and 75% wheat flour.</p>  <p>Potato mandazi</p>
Justification	Blending potato with wheat flour will reduce the cost of mandazi and diversify the use of potato. This will create demand for increased potato production for enhanced food security and income generation. It will also save on money used to import wheat
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms

	<ul style="list-style-type: none"> • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potatoes, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • Processors – potato mandazi • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – preparing/buying potato mandazi
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties producing potato
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Cooking potato mainly roasting and boiled; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added potato products.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	A good value-added product will penetrate the market very fast.

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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination adoption and scaling up	<ul style="list-style-type: none"> • Potatoes stakeholder might not be aware that potatoes can be used to make mandazis • Women might not have the necessary skills to make potato mandazi due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of mandazi is labor intensive hence increase labor form women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	<ul style="list-style-type: none"> • Potato stakeholder might not be aware that potatoes can be used to make mandazis • Women might not have adequate skills to make potato mandazi due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of mandazi is labor intensive hence increase labor for women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase other flour products for blending • Women and youth stand to benefit in production, use and sale of potato mandazi • There will be improvement in food security and nutrition for women and youth • There will be a reduction in post harvest losses for potatoes
VMG issues and concerns in development and	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure

dissemination adoption and scaling up	<ul style="list-style-type: none"> • Lack of participation by all VMGS hence they might not have skills and knowledge of processing potatoes skills due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Potato mandazi recipe books, leaflets and manuals
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 -Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Francis Wayua, James Ndambuki and Harun Odhiambo
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.9.7 Potato Buns


TIMP Name	Potato Buns
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of potato tubers
What is it? (TIMP description)	<p>Potato/wheat buns made from composite flour of 25% potato and 75% wheat flour.</p>  <p>Potato buns</p>
Justification	Blending potato with wheat flour will reduce the cost of buns and diversify the use of potato. This will create demand for increased potato production for enhanced food security and income generation. It will also save on money used to import wheat.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potato tubers, availability of quality standards • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potatoes into

	various products; the government should facilitate affordable credit to empower farmers take up potato agribusiness
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers • Counties facilitate the extension staff and provide grants to the farmers • CIGs play the role of adoption of the technologies through their various groups • Processors – processing • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – preparing and/or buying potato buns
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • 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 to establish value added enterprises • Limited consumer awareness of value added potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	A good value added product will penetrate the market very fast.
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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined

Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Potato stakeholder may not be aware that potatoes can be used to make buns • Women might not have the necessary skills to make potato buns due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato buns is labor intensive hence increase labor form women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato buns • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for potatoes
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of making potatoes buns due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Potato buns production leaflets and manuals
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 -Tigoni Potato Research Centre P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Ndambuki J., Wayua F. and Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs (e.g.) • Hotels, restaurants, food processing companies • Exporters

2.9.8 Potato Fritters


TIMP Name	Potato Fritters
	<ul style="list-style-type: none"> • Innovations
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Limited utilization of potato tubers
What is it? (TIMP description)	<ul style="list-style-type: none"> • Grated fresh potato tubers combined with wheat flour, eggs and spices. The combination is deep fries, cooled and packaged.  <p>Potato fritters Source: cookitrealgood.com</p>
Justification	<ul style="list-style-type: none"> • Diversification of potato products will enhance consumption of potato, enhance demand and thus spur increased production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, extension agencies, small-scale processors, agripreneurs, traders, restaurants, consumers.
Approaches used in dissemination	<ul style="list-style-type: none"> • On farm demonstration and training • Brochures on post-harvest handling of potato tubers • Seminars to create awareness • Farmer exchange visits and study tours • Capacity building – Common Interest Groups (CIG) • Establishment of collection centres

	<ul style="list-style-type: none"> • ICT (WhatsApp and mobile apps)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potatoes, availability of quality standards.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • Processors – processing commercial potato fritters • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – Prepare/buying potato fritters
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • Limited awareness of product by farmers and consumers; limited processing technology at the household level. Potatoes are mainly utilized in roasted and boiled forms; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	A good value added product will penetrate the market very fast.
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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Not yet determined
Estimated returns	Increased income and nutrition from sale and consumption of potato fritters
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women might not be aware of potato fritters. • Women and the youth might not have the necessary skills of making potato fritters due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato fritters is labor intensive hence increase labor form women • Women have limited markets to sell potato products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for mixing
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato splitters • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for potatoes
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of making potato fritters due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Potato fritters production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up	1-Ready for up scaling

scaling; 2. Requires validation; 3. Requires further research)	
G: Contacts	
Contacts	Centre Director, KALRO -Tigoni Potato Research Centre P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Ndambuki J., F., Wayua and H., Odhiambo
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.9.9 Potato/Wheat Noodles


TIMP Name	Potato/Wheat noodles
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of potato tubers
What is it? (TIMP description)	<p>Potato/wheat noodles made from composite flour of 25% potato and 75% wheat flour.</p>  <p><i>Potato noodles</i></p>
Justification	Blending potato with wheat flour will reduce the cost of noodles and diversify the use of potato. This will create demand for increased potato production for enhanced food security and income generation. It will also save on money used to import wheat.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers.

Approaches used in dissemination	On-farm experimentation and practical demonstration of preparation process, field days, shows, exhibitions, Farmer Field and Business Schools, Innovation Platforms (IPs), farmer exchange visits.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potato tubers, availability of quality standards. • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potatoes into various products; the government should facilitate affordable credit to empower farmers take up potato agribusiness.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • Processors – processing commercial production of potato noodles • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – preparing and/or buying potato noodles
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up scaled	All counties producing potato
Challenges in development and dissemination	<ul style="list-style-type: none"> • 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 potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation about the product to farmers, consumers and other value chain actors. • Acquisition of noodle production machines • 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 potato products; nutrition education to consumers

Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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 potato agribusiness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Not yet estimated
Estimated returns	<ul style="list-style-type: none"> • Increased income through production and sale of potato value added products
Gender issues and concerns in development, dissemination adoption and scaling up	<p>Potatoes stakeholder might not be aware that potatoes can be used to Potato/wheat noodles</p> <p>Women might not have the necessary skills to make Potato/wheat noodles due to limited access to agricultural information and extension services</p> <ul style="list-style-type: none"> • Making of potato buns is labor intensive hence increase labor form women • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending and processing
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato wheat noodles • There will be improvement in food security and nutrition for women and youth • There is reduced post -harvest losses for potatoes
VMG issues and concerns in development, dissemination in adoption and scaling up	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of making potato/wheat noodles due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs • VMGs will have diversified family diet and generate income at village level by making the products for sale

E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> •
Application guidelines for users	<ul style="list-style-type: none"> • Potato noodles production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2-Require validation
G: Contacts	
Contacts	Centre Director, KALRO -Tigoni Potato Research Centre P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Wayua F., Ndambuki J. and Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.9.10 Potato/Wheat Doughnuts

TIMP Name	Potato/Wheat Doughnuts
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of potato tubers
What is it? (TIMP description)	Potato/wheat made from composite flour of 25% potato and 75% wheat flour.  <i>Potato doughnuts</i>
Justification	Blending potato with wheat flour will reduce the cost of doughnuts and diversify the use of potato. This will create demand for increased


	potato production for enhanced food security and income generation. It will also save on money used to import wheat
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • On-farm experimentation and practical demonstration of preparation process, field days, shows, exhibitions, Farmer Field and Business Schools, Innovation Platforms (IPs), farmer exchange visits
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality potato tubers, availability of quality standards. • Farmers should organize themselves into growers' associations which facilitate setting up of factories to process potatoes into various products; the government should facilitate affordable credit to empower farmers take up potato agribusiness.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Farmers – for activity implementation and promotion • Agricultural extension and advisory services will offer technical advisory services to the farmers. • Counties facilitate the extension staff and provide grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • Processors – processing of potato doughnuts • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement • Consumers – preparing and/or buying potato doughnuts
C: Current situation and future scaling up	
Counties where already promoted, if any	<ul style="list-style-type: none"> • Bomet, Nakuru
Counties where TIMPs will be upscaled	All potato producing counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • 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 potato products
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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

	<ul style="list-style-type: none"> • 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 potato products; nutrition education to consumers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Not yet determined
Estimated returns	<ul style="list-style-type: none"> • Increased income and nutrition from sale and consumption of potato biscuits
Gender issues and concerns in development, dissemination, adoption and scaling up	<p>Women might not be aware that potatoes can be mixed with wheat to make Potato/wheat doughnuts</p> <p>Women might not have the necessary skills to make Potato/wheat doughnuts due to limited access to agricultural information and extension services</p> <ul style="list-style-type: none"> • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of potato /wheat doughnuts is labor intensive hence increase labor for women who have other roles • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending and mixing
Gender related opportunities	<ul style="list-style-type: none"> • Women and youth stand to benefit in production, use and sale of potato/wheat doughnuts • There will be improvement in food security and nutrition for women and youth • There is reduced post- harvest losses for potatoes
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing potatoes due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> • VMGs have had limited markets to sell potato products due to limited mobility and exposure

	<ul style="list-style-type: none"> • Lack of participation by all VMGS hence they might not have skills and knowledge of making Potato/wheat doughnuts due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of potatoes since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	<ul style="list-style-type: none"> • There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from potato flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Potato doughnuts recipe leaflets and manuals
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 -Tigoni Potato Research Centre P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni Wayua F., Ndambuki J. and Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture (County Governments) • CBOs and NGOs • Hotels, restaurants, food processing companies • Exporters

2.10 TIMPS on Potato Mechanization

2.10.1 Power Tiller


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	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in a commercialized Potato 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) 	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 manoeuvrability of conventional tractors while manual labour is slow and costly.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers and researchers, manufacturers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)

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	Nakuru, Nyandarua
Counties where TIMP will be up scaled	Elgeyo Marakwet, Nyeri, Nyandarua, Bomet, Taita Taveta and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Power tiller machine is complicated for women to operate • The power tiller is also expensive for women to afford • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization • Men dominate most decisions at the household and community levels hence determines the type of equipment to be used for tilling potato farms facilities to be used in farms • Tilling of land was predominantly for men but with the introduction of the machine women have been drawn to the activity • Potato tilling machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • Affordability to all gender

Gender related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for women farmers as well as men • With the introduction of the power tiller women have been attracted to tilling
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Operating Power tiller is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge especially relating to the tiller in potatoes farms • VMGs have limited finances to pay services and to purchase Power tiller due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Potato tiller need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for VMGs • Increases food production and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	Nasirembe.wanyonyi@kalro.org
Lead organization and scientists	KALRO, Egerton University Nasirembe W.
Partner organizations	Local Fabricators

2.10.2 Wheeled Tractor 50Hp

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	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in a commercialized Potato 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) 	A small sized, a 4 wheeled tractor is a low powered agricultural implement of 40-55hp 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 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 threshing through a power take off device and transporting produce. Farm sizes less than one hectare may limit manoeuvrability of conventional tractors and manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers and researchers, agriprenuers
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets, and KTM12 manuals) i.e. Pamphlets • Mass media and Web materials, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and Business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
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	Nyandarua, Nakuru

Counties where TIMP will be up scaled	Elgeyo Marakwet, Nyeri, Nyandarua, Bomet, Taita Taveta and Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of tractors • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	KES 450,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • A wheeled tractor 50Hp is gender unfriendly hence it cannot be operated by women • Women and youth have limited finances to pay services and to purchase farm machines such as wheeled tractor 50Hp due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence they make decisions relating to land preparation for potatoes farms • Potatoes farming machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • There is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Promotes inclusivity of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Operating wheeled tractor 50Hp is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not know where to get a wheeled tractor 50Hp

	<ul style="list-style-type: none"> • VMGs have limited finances to pay services and to purchase a wheeled tractor 50Hp and other farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the tractor • Linking the VMG to financial institutions would enable them to purchase the tractor since it is affordable and easy to maintain machines
VMG related opportunities	<ul style="list-style-type: none"> • Creates employment at production, transportation, processing and distribution for VMGs • Reduces drudgery for VMG farmers
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	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1. 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

2.10.3 Mouldboard Plough

TIMP Name	Mouldboard Plough
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in a commercialized Potato 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)	Mouldboard plough is an agricultural implement and is generally considered to be the important tillage implement.

	<p>Mouldboard ploughs are available for power tiller and tractor operation. A mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. C) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation.</p>  <p><i>Mouldboard plough</i></p>
Justification	<p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers and researchers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)</p> <p>Machinery fabricators</p> <p>NGO supporting farmers for dissemination</p>
C: Current situation and future scaling up	

Counties where already promoted if any	All potato growing counties
Counties where TIMP will be up scaled	Elgeyo Marakwet, Bomet
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited finances to pay services and to purchase farm machines such as Mouldboard due to limited access to credit facilities • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in their farms • Mouldboard plough is not easy to operate especially for women and also expensive to purchase • Up-scaling should target all the gender • There is need to equip women, youth and stakeholders with information relating to the TIMP • Linking the women and youth to financial institutions would enable them to buy since it is affordable and easy to maintain machines
Gender related opportunities	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Operating mouldboard plough is complex for some VMGs especially those who are abled differently

	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines²
VMG related opportunities	<p>Can create employment for VMG at local level</p> <p>Reduces drudgery for VMGs</p>
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	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	<p>The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katamani@kalro.org Phone: 0711369535</p>
Lead organization and scientists	Nasirembe W, KALRO, Egerton University
Partner organizations	Local Fabricators

2.10.4 Harro

TIMP Name	Harrow
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in a commercialized Potato 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)	It is an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up clods,


	<p>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.</p> <div> </div> <p><i>Harrow</i></p>
Justification	<ul style="list-style-type: none"> • 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	Potato farmers and researchers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, Universities (for information) • Machinery fabricators • NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	All potato growing Counties

Counties where TIMP will be up scaled	Elgeyo Marakwet, Uasin Gishu, Bomet, Taita Taveta, Nyeri, Nyandarua
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Harrow is gender unfriendly hence it can not be operated by women • The machine is expensive for potatoes stakeholders to purchase especially women • Women and youth have limited finances to pay services and to purchase farm implements such as harrow due to limited access to credit facilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels hence determines the type of machines to be used in potato farms • Potato machines should be designed for easy start and operation. • Up-scaling should target all the gender • There is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attracts participation of all genders

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Operating a harrow is complicated for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not be aware of the existence of a harrow and how it is operated • VMGs have limited finances to pay services and to purchase farm machines due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Potato machines need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordability and easy to maintain by all types of farmers
VMG related opportunities	<ul style="list-style-type: none"> • Can create employment for VMG at local level • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	1. 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

2.10.5 Potato Planter

TIMP Name	Potato Planter
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seed placement


	<ul style="list-style-type: none"> • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation leading to late planting • High cost of manual labour
What is it? (TIMP description)	<p>A potato planter is a device used in agriculture that opens furrows meters, sows seeds for potato by positioning them in the soil and burying them to a specific depth and forms a ridge along the seed row. The potato planter sows seeds at the proper seeding rate and depth, ensuring that the seeds are covered by soil.</p>  <p><i>Potato planter</i></p>
Justification	<ul style="list-style-type: none"> • Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Potato seed is large making planting depth critical and difficult to attain when manually done and seed shallowly planted will germinate with poor yields • Row 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	Potato farmers and researchers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost.
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)</p> <p>Machinery fabricators</p> <p>NGO supporting farmers for dissemination</p>
C: Current situation and future scaling up	

Counties where already promoted if any	Nyandarua and Nakuru
Counties where TIMP will be up scaled	Elgeyo Marakwet, Bomet, Nyeri, Taita Taveta, Uasin Gishu and Nyandarua
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Potatoes seed driller is gender unfriendly so it is not easily operated by women • Potatoes seed driller is expensive for women and the youth to purchase • Potato seed driller should be designed for easy start and operation. • Up-scaling should target all the gender • Potato seed driller should be affordability, for all gender and to all gender • Up-scaling of potato seed driller should target all gender
Gender related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It attract participation of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited finances to pay services and to purchase potato seed driller since they do not have to limited access to credit facilities • Operating a potato seed driller is complex for some VMGs especially those who are abled differently • VMGs need to be equipped with information relating to a potato seed driller

	<ul style="list-style-type: none"> • Potato seed drillers need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable and easy to maintain for all types of farmers
VMG related opportunities	<ul style="list-style-type: none"> • Can create employment for VMG at local level • It makes work easier for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice.
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katamani@kalro.org ; Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.6 Motorised Sprayer

TIMP Name	Motorised 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 Potato.
What is it? (TIMP description)	<p>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.</p> <p>In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops.</p> <p>Sprayers are man-portable units typically backpacks with spray guns. They are used to control; weeds that can harbour insects by use of</p>


	<p>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.</p> <div><table><caption>Nozzle Guide for Band and Directed Spraying</caption><thead><tr><th></th><th>Even Flat Fan</th><th>Not Even Flat Fan</th><th>Hollow Cone</th><th>Full Cone</th><th>Disk and Core Cone</th></tr></thead><tbody><tr><td>Herbicides</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Pre-emerge</td><td>Very Good</td><td>Good</td><td></td><td>Good</td><td></td></tr><tr><td>Post-emerge Contact</td><td>Good</td><td>Very Good</td><td>Very Good</td><td></td><td></td></tr><tr><td>Post-emerge Systemic</td><td>Very Good</td><td></td><td></td><td></td><td></td></tr><tr><td>Fungicides</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Contact</td><td>Good</td><td></td><td>Good</td><td></td><td>Very Good</td></tr><tr><td>Systemic</td><td>Very Good</td><td></td><td></td><td></td><td>Good</td></tr><tr><td>Insecticides</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Contact</td><td></td><td>Very Good</td><td>Very Good</td><td></td><td>Very Good</td></tr><tr><td>Systemic</td><td>Very Good</td><td></td><td></td><td></td><td>Good</td></tr><tr><td>Growth Regulators</td><td>Good</td><td></td><td></td><td>Very Good</td><td></td></tr></tbody></table></div>		Even Flat Fan	Not Even Flat Fan	Hollow Cone	Full Cone	Disk and Core Cone	Herbicides						Pre-emerge	Very Good	Good		Good		Post-emerge Contact	Good	Very Good	Very Good			Post-emerge Systemic	Very Good					Fungicides						Contact	Good		Good		Very Good	Systemic	Very Good				Good	Insecticides						Contact		Very Good	Very Good		Very Good	Systemic	Very Good				Good	Growth Regulators	Good			Very Good	
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Growth Regulators	Good			Very Good																																																																					
Justification	<p>Pest reduce yields up to 98% and are a major menace in agricultural production. Before Potato forms a canopy, broad leafed weeds compete with Potato seedling for nutrients and light greatly reducing their yield. Manual sprayer are labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency</p>																																																																								
B: Assessment of dissemination and scaling up/out approaches																																																																									
Users of TIMP	Potato Farmers and agribusiness entrepreneurs																																																																								
Approaches used in dissemination	<ul style="list-style-type: none">• Demo plots• Exhibition, Agricultural Shows• Use of digital platforms• Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets• Mass media and Web material’s, Mobile Apps and SMS, Digital platforms• Regular localized meetings• Farmer field and business Schools (FFBS)• Public and private agricultural extension services• Agricultural Innovation Platforms (AIP)																																																																								
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C: Current situation and future scaling up																																																																									
Counties where already promoted if any	Nakuru																																																																								
Counties where TIMP will be up scaled	Nyeri, Nyandarua, Taita Taveta, Uasin Gishu, Bomet and Elgeyo Marakwet																																																																								
Challenges in dissemination	<ul style="list-style-type: none">• Relatively High cost for individual small-scale farmer.• Limited awareness of the existence of machine by the farming community.																																																																								

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	<ul style="list-style-type: none"> • Motorized sprayer is designed for easy start and operation hence it is gender friendly and can be used by women also • Women and youth have limited finances to pay services and to purchase a motorized sprayer for use in potato farms due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to so they might not be aware of the of motorized sprayer • Men dominate most decisions at the household and community levels hence determines the type of farm equipment and machines to be used in potato farms facilities to be used in farms • Men have been drawn to spraying by the machine. • This task was predominantly for women before the introduction of the machine
Gender related opportunities	<ul style="list-style-type: none"> • Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It promote gender inclusivity reducing the work load for women2
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited finances to pay services and to purchase motorized sprayer due to limited access to credit facilities • Operating potato motorized sprayer is complex for some VMGs especially those who are abled differently • Potato motorised sprayers need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable and easy to maintain by all types of farmers
VMG related opportunities	<ul style="list-style-type: none"> • Can create employment for VMG at local level • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice

Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	1. 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
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Motorized sprayer designed for easy start and operation. Men have been drawn to spraying 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
Gender related opportunities	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Facilitation to access information • Affordability and easy to maintain machines
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	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	1. 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

2.10.7 Harvester

TIMP Name	Harvester
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • 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 potatoes are left on the farm
What is it? (TIMP description)	<p>A Potato harvester is a machine that harvests potatoes. It works by lifting the potatoes from the bed using a share. Soil and crop are transferred onto a series of webs where the loose soil is sieved out. The potatoes 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 potatoes then go on to a side elevator and into a trailer or a potato box.</p>  <p><i>A potato harvester</i></p>
Justification	Manual potato harvesting can cover low acreage within a stipulated time and may delay in bad weather. Manual harvesting is dependent on labour and requires 20 people per hectare while a potato harvester


	will require only a team of three. A part from lack of labour, the cost of harvesting is saved by at least 60 percent.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Use by Farmers will make it popular.
Partners/stakeholders for scaling up and their roles	<p>Machinery fabricators - production</p> <p>NGO (AGGRA) - supporting farmers to access the harvester</p>
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Nyandarua, Meru
Counties where TIMP will be up scaled	Nyeri, Nyandarua, Taita Taveta, Uasin Gishu, Bomet and Elgeyo Marakwet
Challenges in dissemination	<ul style="list-style-type: none"> • Relatively High cost for individual small-scale farmer • Limited awareness of the existence of machine by the farming community
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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 their growth
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • 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	Potato harvester 125,000 KES per unit
Estimated returns	<p>Capacity 500 Kg/ hour, Fuel 1 litre /hr (4-5 bags)</p> <p>Needs 3 operators per time</p> <p>Harvesting charges: KES 300 per bag</p> <p>Requires 1 season to return the KES 125,000 purchase price</p>

Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	<ul style="list-style-type: none"> • Potato harvester is designed for easy start and operation • Men have been drawn to Potato harvester by the machine, harvesting was predominantly done by women before the introduction of the machine • Potato harvester is gender friendly, it is easy to operate enabling women to use • Potato harvester is expensive for stakeholders especially women • Women and youth have limited finances to pay services and to purchase farm machines such as a potato harvester due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization • Men dominate most decisions at the household and community levels hence determines the type of machines to be used in farms • Potato harvesters should be designed for easy start and operation. • Up-scaling should target all the gender and they should be affordable to all gender
Gender related opportunities	<ul style="list-style-type: none"> • Reduced labour intensity in threshing • High productivity is increased food security and nutrition • Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMGs issues and concerns in development ,dissemination, adoption and scaling up dissemination	<ul style="list-style-type: none"> • VMGs have limited finances to pay services and to purchase farm machines such as a potato harvester due to limited access to credit facilities • Operating a potato harvester is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to potato harvesters • Linking the VMG to financial institutions would enable them to buy potato harvesters • Potato harvesters need to be designed in such a way that would enable people able differently to operate • In addition they need to be affordable
VMGs opportunities	<ul style="list-style-type: none"> • Reduced labour intensity in for VMGs • High productivity is increased food security and nutrition for VMGs • Creates employment for VMGs • Reduces drudgery for VMGs farmers
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	<p>Gender Unfriendly and expensive machines</p> <p>Potato machines should be designed for easy start and operation.</p> <p>Up-scaling should target all the gender</p> <p>Affordability to all gender</p>

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	Facilitation to access information Affordability and easy to maintain machines
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 and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	3- Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Training on local use and transportation will make it more usable. • Thresher is affordable and could help VMGs exploit
VMG related opportunities	Can create employment for VMG at local level
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 Egerton University,
Partner organizations	Tecsols Ltd – Nakuru

2.10.8 Grader

TIMP Name	Grader
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • 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 potatoes are left on the farm
What is it? (TIMP description)	<p>The potato grader is a machine with PVC rollers that rotate potatoes to allow quality inspection, and finally grades on three to six sizes. It has a bag closing device and weighing system that enables direct packing. It has a conveyor at the bottom of the hopper. The machine is automatic feeding and can carry a large capacity.</p> <p>Roller inspection tables - roller conveyor provides an efficient and affordable way to keep product constantly rotating when manual inspection is required.</p> <p>Variable speed – Variable-speed operation can be achieved either by mechanical or electrical adjustment.</p> <p>Discharging Conveyors- Gentle and durable belts can carry product to either side of the Sizer. The end section has got a Bag closing device or slope exit for ease of packing.</p> <div style="text-align: center;">  <p><i>Grader</i></p> </div>
Justification	<p>Manual potato grading takes a long time to grade a unit measure of potato normally 25kg and may delay till the potatoes start rotting. Manual grading is labour dependent which is relatively expensive. Manual grading cost is saved by at least 60 percent.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Demo plots • Exhibition, Agricultural Shows • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets and KTM12 manuals) i.e. Pamphlets

	<ul style="list-style-type: none"> • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Regular localized meetings • Farmer field and business Schools (FFBS) • Public and private agricultural extension services • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Continued use by farmers will lead to its popularity.
Partners/stakeholders for scaling up and their roles	Machinery fabricators – production of graders NGO (AGGRA) - supporting farmers to obtain the machines
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Kiambu, Nyandarua, Nakuru, Narok, Uasin Gishu
Counties where TIMP will be up scaled	Nyeri, Nyandarua, Taita Taveta, Uasin Gishu, Bomet and Elgeyo Marakwet
Challenges in dissemination	<ul style="list-style-type: none"> • Relatively High cost for individual small-scale farmer • Limited awareness of the existence of machine by the farming community
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage group/cooperative ownership • Launch an 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 their growth.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community • Inclusion of 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	Potato thresher costs KES 125,000 per unit
Estimated returns	Capacity 500 Kg/ hour, Fuel 1 litre /hr (4-5 bags) Needs 3 operators per time. Harvesting charges: KES 300 per bag Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Potato Thresher designed for easy start and operation. Men have been drawn to Potato threshing 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.
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
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 and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	3. Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katamani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators

2.11 Smallholder Potato Farming Business and Marketing

2.11.1 Transformative Model of potato production

TIMP Name	Transformative Model of Potato Production
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low potato productivity of about 1.4 tons per acre due to non-transformative farming among the smallholder farmers. The smallholder farmers use poor management practices in the production of potato. The smallholder farmers use poor quality planting materials. The planting materials are accessed through the informal sector. Potato is produced both for food and cash. However, farmers need to transform from subsistence to semi-commercial to fully commercial.
What is it? (TIMP description)	Transformative model of potato production involves three levels of shifting. As farmers gain production skills and improved access to markets, the production of potato 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	The transformative model drives farmers and links them to markets. Market failures or missing markets have led to disorganization in potato market-oriented production. Due to the disorganization in market-oriented production of potato, smallholder farmers fail to access markets or have limited market linkages..
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Availability of traders and other upstream actors Acceptance of smallholder farmers to form production organizations Investments in the production of quality tradable volumes Acceptance of the potato-improved varieties by consumers Adaptability of the potato varieties Prices of potato Availability of storage infrastructure and transport
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Farmers – Formation of production groups, investments in potato 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 potato production Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet

Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the potato 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 potato varieties • Levels of production constraints • Level of policy support • High perishability of potato
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of production clusters • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Use of promotion channels for instance media and field days • Capacity building on the group dynamics and management • Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Promotion of new potato varieties through field days. • Value addition, producer organization, managing costs in production, capacity building on farming as a business • Enhancing adoption of Potato TIMPs • Use of National agricultural strategies. Lobbying for the County support in policy options • Improved varieties with prolonged period of perishability
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • High market competition with other potato varieties • Agro-ecological zone considerations • The transformative process is constraints by many factors, for instance subsistence levels, ecological requirements, policy support, access to markets
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are usually left out when potato marketing groups and innovation platforms are being formed due to their social economic status in the society • Women do not have time to attend organized meetings due to their busy schedules • Women might not be aware of the existing potato marketing groups • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> • Increased profitability • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing potato marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to potato production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	<ul style="list-style-type: none"> • Increased profit for VMGs • \Improved access to market within and without by VMGs • Increased access to market information and channels by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Productivity increase projects in Nyandarua (29.8 per cent) and Elgeyo Marakwet (16.2 per cent).
Application guidelines for users	<ol style="list-style-type: none"> 1. Trainings, 2. Potato production hand book-

	3. KALRO factsheets- www.kalro.org , 4. Potato manuals 5. Power points
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,
Partner organizations	Ministry of Agriculture & Livestock Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

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 Profitability analysis

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 potato productivity due to lack of profitability analysis leading to low income. This contributes to inaccessibility of improved production inputs. The problem of failure of profitability analysis is common among the smallholder farmers of potato. 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, returns and therefore determination of profit which indicates the performance of the potato agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain.
Justification	Without profitability analysis in potato production, farmers are unable to review the management success and sustainability of the potato farming business. Lack of profitability analysis indicates areas of adjustment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farmers, agripreneurs, farmers' groups, traders in the value chain
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Production programme • Availability of data on quantities of inputs requirements, costs, outputs and value • Literacy levels of farmers • Formation of producer organizations
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the potato production and marketing

	<ul style="list-style-type: none"> • Defining production programmes of potato • Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of production clusters • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Developing information hub and capacity building • Developing a SWOT analysis • Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women engaging in potato production have not been to make profits from the sale of their produce due to limited knowledge in profit analysis. • Women are associated with poor performance within the potato value chain has been attributed to their lack of comparison of costs and returns • Most women farmers especially those involved in potato production are semi-illiterate hence they are not able keep records on potato production costs and on their sales • Women and youth have limited access to agricultural information and extension especially relating to marketing of potatoes • Women are usually left out when key decisions are being made relating to the potato value chain • Women do not have time to attend organized meetings due to their busy schedules • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities
Gender related opportunities	<ul style="list-style-type: none"> • There will be increased markets local and distance increasing incomes for women and youth

	<ul style="list-style-type: none"> • There will be increase employment for women and youth at various nodes of potatoes value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited information on marketing hence being exploited by middle men • The VMGs do not have access to external markets • The VMGs have limited finances which limits them from paying for services such as trainings • VMGs have limited access to agricultural information and extension especially relating to marketing of potatoes • VMGs are usually left out when key decisions are being made relating to the potato value chain • VMGs have limited finances to pay services such as training due to limited access to credit facilities • VMG farmers especially those involved in potato production are semi-illiterate hence they would not be able to keep records on the costs incurred in potato production and finances acquired after the sale of potatoes and products
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased potato markets for VMGs • There will be increase employment for VMGs at various nodes of potatoes value chain • Improve livelihoods for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Potato income generating projects
	<ol style="list-style-type: none"> 1. Trainings 2. KALRO factsheets- www.kalro.org , 3. Potato manuals 4. Power points
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	<ol style="list-style-type: none"> 1. Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni,

	Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,
Partner organizations	Ministry of Agriculture & Livestock, Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

Further research

1. Establishing opportunities with high profit
2. Impact of profitability analysis on production

2.11.3 Market Research

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	Low potato productivity due to farmers' failure in engagement in market research. This leads to lack of knowledge on input and outputs markets. The smallholder farmers lack market information on outlets and prices. This leads to information asymmetric among farmers of potato.
What is it? (TIMP description)	Market research is a practice by farmers to gather market information to help them in business planning and organization of the production.
Justification	Without market research, the potato farmers in many remote areas will continue with lack of understanding on how the markets work or why prices fluctuate, with little or no information on market conditions, prices and quality of goods; not organized collectively; no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market and difficult market access which restricts opportunities for income generation. Farmer market research provides relevant data to help solve marketing challenges that farmers most likely face in their potato farming businesses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers, agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	<ul style="list-style-type: none"> • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organization of farmers • Formation of market research group or market opportunity group • Availability of facilitators • Availability of many traders • Production volume and quality • Availability of market information
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	None
Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Lack of appreciation of market opportunity group • Inadequate information to stakeholders on the potato production and marketing Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of producer organization • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Formation of market opportunity group • Developing information hub • Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Literacy levels to support market research • Environmental conditions – Over-use of cultivated land due to over-production of potato • Policy conditions – Policy support in market opportunity groups
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600, The cost of market research is Ksh 2050 (for 41 bags per acre per crop cycle). Total variable cost Ksh. 129,650
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 120,350 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth are left out during the formation of potatoes marketing and innovation platforms • Women sell small quantities of potatoes due to limited finances to purchase improved high yielding seeds • Women have limited access to agricultural information and market information hence exploited by brokers • Women and youth have limited access to education, training and extension services • Women are usually left out when key decisions are being made relating to the potato value chain • There is need for involvement of youth, men and females in the marketing organization committee • There is need to promote inclusion of youth, males and females during marketing dissemination workshops
Gender related opportunities	<ul style="list-style-type: none"> • Increased production and sales of potato by youth, females and males in the production of Potato. • Increase in production and sales by youth, females and males in the production of cotton. • Increased market outlets for women and youth
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are usually left out during the formation of potato marketing groups hence they do not get new information relating to the value chain • VMGs have limited information on marketing hence being exploited by middle men • The VMGs do not have access to external markets since they have limited information on existing distance markets • The VMGs have limited finances which limits them from paying for services such as trainings

	<ul style="list-style-type: none"> • VMG farmers especially those involved in potato production are semi-illiterate and are not able to understand any information relating to high yielding varieties
VMG related opportunities	<ul style="list-style-type: none"> • Increased production and sales of potato by VMGs . • Increase in production and sales by VMGs • Increased market outlets for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ol style="list-style-type: none"> 1. Trainings, 2. KALRO factsheets- www.kalro.org , 3. KALRO manuals – www.kalro.org 4. Power points
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	<ol style="list-style-type: none"> 2. Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
	KALRO-Tigoni, Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,
Lead organization and scientists	Ministry of Agriculture & Livestock Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs
Partner organizations	

GAPS

Further research

1. Performance of market opportunity groups
2. Sustainability of the market opportunity groups
3. Equity distribution in sales and income

2.12.4 Collective marketing

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 potato productivity due to the lack of the smallholder farmers' security in accessing new technologies, non-utilization of high-value markets and failure to improve access to credit facilities. Instead, the smallholder farmers do marketing of potato individually without the targets. Smallholders acting alone typically lack the production volume and the bargaining power to command on-time delivery of agricultural inputs at reasonable prices.
What is it? (TIMP description)	Collective marketing through farmers' groups has been identified as a strategy to improve the participation of small scale farmers in markets. Collective marketing promotes the empowerment of farmer groups and allow them to overcome specific barriers to becoming part of market economy. 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	There is high demand for the Irish potato in Kenya. However, small scale farmers do not benefit much as they are not organised in groups to enjoy the benefits of collective marketing. The benefits include reduction in transaction costs, economies of scale and increased bargaining position in the value chain. In the case of potato production in Nakuru County, there is little information on participation of small scale farmers in collective marketing and the factors that influence their participation. Collective marketing has several benefits including: it enables farmers to reduce transaction costs, increase market efficiencies, obtain the necessary market information, secure access to new technologies and utilize high-value markets, improve access to credit facilities, increase economies of scale and improve bargaining power in the value chain which gives them an advantage when competing with large-scale farmers
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, agripreneurs and processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings

	<ul style="list-style-type: none"> • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals <p>Digital Platforms – Website, Dashboards, Apps, social media short message services</p>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of county policies supporting collective marketing of potato • Willingness of farmers • Availability of targeted markets • Availability of agreements
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	None
Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the potato production and marketing • Group dynamics • Levels of policy support • Willingness of farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of production organizations • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Capacity building on sources of information. • Capacity building of the groups • Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Empowerment - Collective marketing empowers smallholder farmers • Increase in productivity - Collective marketing ensures the smallholder farmers' to secure access to improved technologies • Economies of scale – Increased potato production volume

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Uniformity of the marketing group • 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	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women have less access to marketing information • Women do not have time to attend organized meetings due to their busy schedules • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • Women are usually left out when key decisions are being made relating to the potato value chain • Women are usually left out when potato marketing groups and innovation platforms are being formed due to their social economic status in the society • Women might not be aware of the existing potato marketing groups • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Development and dissemination – Involvement of VMGs in the formation of producer organizations • Adoption and scaling up – Definition of roles involving VMGs in the functioning of producer organizations • Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing potato marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to potato production and marketing

	<ul style="list-style-type: none"> • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	<ul style="list-style-type: none"> • Increased profit for VMGs • Improved access to market within and without by VMGs • Increased access to market information and channels by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ol style="list-style-type: none"> 1. Trainings, 2. KALRO factsheets- www.kalro.org , 3. KALRO manuals – www.kalro.org
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	<ol style="list-style-type: none"> 2- Requires validation
G: Contacts	
Contacts	<p>Centre Director, KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 0202023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org</p>
Lead organization and scientists	<p>KALRO-Tigoni,</p> <p>Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,</p>
Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture & Livestock Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

Further research

1. Performance of producer organizations
2. Production efficiency in potato production due to the formation of producer organizations
3. Equity distribution in income

2.11.5 Marketing innovation model

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	Low potato productivity due to low adoption of innovations in production and marketing. As farmers produce and market potato, 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 in potato production and marketing
Justification	Potato marketing innovation involves product diversification and increase in shelf life. Diversification develops various marketing channels of potato products. In-storage practices for increasing shelf life include simple storage structures. Failure to apply innovation in marketing of potato 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, farmer groups, agripreneurs and potato traders
Approaches to be used in dissemination	<ol style="list-style-type: none"> 1. Farmer Field and Business School (FFBS) 2. Agricultural innovation platforms (AIP) 3. Demonstrations - On-farm and on station 4. Agricultural shows/exhibitions/field days 5. Trainings - workshops/Seminars/Meetings 6. Public and private Extension Agents 7. Farmer to farmer extension models 8. Mass media – Electronic and print 9. Publications -posters/brochures/leaflets, manuals

	10. Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	None
Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua
Challenges in development and dissemination	<ul style="list-style-type: none"> • Small-scale farming • Inadequate information to stakeholders on the potato production and marketing • Subsistence farming • Levels of policy support • Literacy levels among the smallholder farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Developing information hub • Adoption of innovations • Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Literacy levels of the smallholder farmers • Environmental conditions – supporting use of innovations • Policy conditions – Policy supporting innovations • Market conditions – Less potato market competition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600. Average costs of innovations are Ksh. 5,000. Total variable costs 132,000
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.280, 000. The gross margin per acre Ksh. 148,000 per crop cycle, calculated after deducting total crop expenditures

Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are usually left out when potato marketing groups and innovation platforms are being formed due to their social economic status in the society • Women do not have time to attend organized meetings due to their busy schedules • Women might not be aware of the existing potato marketing groups • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing potato marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to potato production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	<ul style="list-style-type: none"> • Increased profit for VMGs • Improved access to market within and without by VMGs • Increased access to market information and channels by VMGs

E: Case studies/profiles of success stories

Success stories from previous similar projects	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Application guidelines for users	<ol style="list-style-type: none"> 1. Training 2. KALRO factsheets – www.kalro.org 3. Manuals <p>Power point slides are available</p>

F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	2-Requires validation
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G: Contacts

Contacts	Centre Director, KALRO-Tigoni
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Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,
Partner organizations	Ministry of Agriculture & Livestock, Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

Further research

1. Rates of innovation adoption
2. Levels of subsistence
3. Productivity of Potato
4. Profitability

2.11.6 Contracted potato production model

TIMP Name	Contracted potato production model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low potato productivity due to non-contract farms. The non-contract farms compared to the contract farms are not organized, leading to the dis-organized production among the smallholder farmers
What is it? (TIMP description)	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.. At times beyond buying of the potato outputs, the contractors extend 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	It has been found that, the productivity of potato in the contract farms is 8.84 per cent higher over the potato productivity obtained from non-contract farms per hectare. Gross income is usually two times more in the contracted farms than in the non-contracted farms. Similarly, the net return after deducting fixed costs has been found to be five- and-a-half times more in contract farms than non-contract farms. Benefit-cost ratio on various costs has been found to vary from 2.71 to 2.0 contract farming compared to 1.40 to 1.02 for without contract. Without contract farming smallholder farmers face poor market access for the potato production. 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, agripreneurs, processors
Approaches to be used in dissemination	<ol style="list-style-type: none"> 1. Farmer Field and Business School (FFBS) 2. Agricultural innovation platforms (AIP) 3. Demonstrations - On-farm and on station 4. Agricultural shows/exhibitions/field days 5. Trainings - workshops/Seminars/Meetings 6. Public and private Extension Agents 7. Farmer to farmer extension models 8. Mass media – Electronic and print 9. Publications -posters/brochures/leaflets, manuals 10. Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of willing farmers • Availability of traders • Competitiveness of potato varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	Meru, Elgeyo Marakwet, Nyandarua, Nakuru, Bungoma, Bomet and Laikipia
Counties where TIMPs will be up scaled	All potato growing counties including Meru, Nyeri, Nakuru, Taita Taveta, Nandi, Bomet, Narok, Uasin Gishu, Nyandarua

Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming leading to lack of potato production volume • Inadequate information to stakeholders on contract farming • Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of production clusters • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Developing information hub and capacity building • Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Committed to purchase • Streamlining the potato value chain to benefit farmers and processors • Control of the quality • Meeting the target agreed • Potato farming financing
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • 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	The average basic costs of potato production in contract farms per acre per crop cycle is Ksh. 160,000
Estimated returns	The estimated total return without deducting costs in contract farms is Ksh 360,000 per acre per crop cycle. When taking all costs into account – certified seed potato, nutrients, crop protection, labour, land etc. the gross margin is almost KES 200,000 per acre per season.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are usually left out when potato marketing groups and innovation platforms are being formed due to their social economic status in the society • Women do not have time to attend organized meetings due to their busy schedules • Women might not be aware of the existing potato marketing groups • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • The VMGs have limited access to external markets • Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing potato marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to potato production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	<ul style="list-style-type: none"> • Supporting VMGs in having access to market information and outlets • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ol style="list-style-type: none"> 1. Training 2. KALRO factsheets – www.kalro.org 3. Manuals – 4. Power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	2-Requires validation
G: Contacts	
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Partner organizations	Ministry of Agriculture & Livestock Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

Further research

1. Performance of contracted farming in terms of productivity, sales and profit
2. Equity distribution
3. Improvement in skill and information delivery

2.12.7 Internet/mobile marketing

TIMP Name	Internet/mobile marketing
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low potato productivity due to poor marketing channels. This leads to poor market access caused by inadequate marketing channels, lack of skills and unavailability of 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. The same online strategies can be used while marketing potato production.
Justification	It is possible to use internet and mobile marketing methods in potato production. 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 potato production business 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. As farmers use internet marketing, they face cost reduction.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital platforms – Website, Dashboards, Apps, Social media short message services
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Education levels of the farmers and investors in potato production

	<ul style="list-style-type: none"> • Levels of experiences in potato production • Availability of information on potato production and marketing • Levels of competition among the potato varieties
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Sellers of Potato production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of potato production • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> • Limited digital skills of farmers • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the potato production and marketing • Inadequate internet connectivity • Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganization and scattered farmers – Formation of production organizations • Small-scale farming – allocation of more land to potato production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the potato production – Developing information hub • Inadequate Internet connectivity – Information hub • Level of policy support – support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Use of internet and mobiles engages wide range of buyers • Improved efficiency in marketing
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – literacy levels of the smallholder farmers • Environmental conditions – None • Policy conditions – Policy supporting information hub
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600

Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Most women have limited information on how they can use internet to market their potato products • Women are usually poor and they lack access to modern mobile devices due to limited finances to buy airtime • There is inadequate information on the potato production and marketing and profitability for women in the internet • Women and youth have limited finances to pay services unlike men due to limited access to credit facilities • Women have limited access to education, training and extension services. • Some of the potato women farmers are semi- illiterate hence might not be able to understand the information acquired through the social media since it is usually in English or Swahili
Gender related opportunities	<ul style="list-style-type: none"> • Job creation for youth in availing information and in selling mobile phones • If adopted there will be an increased and wider potato markets for women and the youth • There will be increased production of potatoes for women hence improved livelihoods • There will be improved food security and nutrition for women
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Most VMGs have limited knowledge and skill on the use of internets to market their potato products • VMGs are usually poor and they lack access to modern mobile devices • There is inadequate information on the potato production and marketing and profitability for VMGs
VMG related opportunities	<ul style="list-style-type: none"> • Job creation for VMGs in availing information and selling mobile phones • If adopted there will be increased and wider potato markets for VMGs • There will be improved production of potatoes by VMGs leading to improved livelihoods • There will be improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Improved market access

	<ul style="list-style-type: none"> Reduction in the costs of market search for the potato production by traders
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)	2-Requires validation
G: Contacts	
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Partner organizations	Ministry of Agriculture, Livestock, and Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

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

2.11.8 Building a Business plan for potato production

TIMP Name	Building a Business plan for potato production
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low potato productivity due to farmers' unplanned and traditional production, leading to untargeted production levels, losses and lack of market orientation.
What is it? (TIMP description)	A business plan is a document which guides the potato business operations in a farm. The document contains business details, such as introduction, business organization, products, marketing strategy, risks, business operation plan, marketing costs, income streams, profit and loss analysis and financial requirements. The business

	plan provides a roadmap for the potato small farm business, an overall vision and mission to drive the business.
Justification	As the smallholder farmers continue transforming from the subsistence production level to semi-commercial to fully commercial, there is need to develop skills in building a business plan. Potato farming without a business plan is likely to fail because it lacks analysis of the production information, market information, financial support and business services. Building potato 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, agripreneurs, financial support services
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital platforms – Website, Dashboards, Apps, Social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Education levels of farmers • Small-scale farming of Potato • Traditional farming of Potato • Availability of information on Potato production and marketing • Availability of farm business plan
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	None
Counties where TIMPs will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the potato production and marketing • Levels of education of farmers

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of production organizations • Allocation of more land to potato production and aggregation of production to assume large scale-farming • Developing information hub • Farmers Trainings
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Increased productivity due to the targeted potato production • Increased income due to the identified markets • Efficiency in farm operations
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Literacy levels among the smallholder farmers • Environmental conditions – Business plans to include Natural Resource Management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre is Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are usually left out when potato marketing groups and innovation platforms are being formed due to their social economic status in the society • Women do not have time to attend organized meetings due to their busy schedules • In most cases it is usually a men enterprise and women are generally discriminated in rural producer organizations. • Women have limited information on existing marketing models and groups • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Women sell their potatoes locally due to limited access to market information • Strict rules of entry and requirements of producers' organizations may limit women participation • There is need to include all genders in the development and dissemination of potatoes business plans.
Gender related opportunities	<ul style="list-style-type: none"> • Increased management skills among youth, women and men participating within potatoes value chain • There is potential of increased profitability for potatoes farmers especially women • Increased market information and channels for women and youth hence increased employment for them

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing potato marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to potato production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	<ul style="list-style-type: none"> • Increased management skills for VMGs • Increased profitability for VMGs • Improved access to market within and without by VMGs • Increased market information and channels by VMGs hence increased job 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)	2-Requires validation
G: Contacts	
Contacts	The Centre Director KALRO-Tigoni P.O. Box 338-00217, Limuru, Kenya Telephone: 020-2023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
Lead organization and scientists	KALRO-Tigoni, Moses Nyongesa, Nancy Ng'ang'a, Judith Oyoo, Susan Otieno, Patrick Pwaipwai, Miriam Mbiyu, Jackson Kilonzi,
Partner organizations	Ministry of Agriculture, Livestock and Development (MOALD), International Potato Centre (CIP), National Potato Council of Kenya (NPCK), International Centre for Insect Physiology and Ecology (ICIPE), FAO, Common Interest Groups (CIGs), GIZ, NGOs

GAPS

1. Adoption rate on the use of farm business plan
2. Performance of the farm business plans

2.12 Agricultural Policy Options

2.12.1 National Potato Policy Strategy

TIMP Name	The National Potato Policy Strategy
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The national potato production and quality continues to remain below its potential, largely due to limited use of clean seed, low or sub-optimal use of fertilizer and ineffective use of pesticides. The major challenges facing smallholder producers, include low productivity due to low adoption of recommended agronomic practices, unfavourable weather, high disease prevalence, inefficient marketing chains, and poor infrastructure.
What is it? (TIMP description)	The National Potato Strategy analyzed the major stakeholders and their core functions in the potato industry. The potato strategy has been developed with a view to provide a road map for the industry players and to create opportunities to develop the industry by addressing identified constraints. This Strategy is intended to harmonize the activities of different players and fully utilize their synergies and complementarities in potato industry.
Justification	In spite the importance of potato industry, there has been no roadmap to guide the subsector initiatives and harmonization of interventions. Thus efforts to improve the industry have been uncoordinated and ineffective leading to inefficient use of resources and duplication of efforts. There is need, therefore, to develop a comprehensive strategy to guide the potato industry into prosperity The National Potato Development Strategy focuses on seven strategic objectives: strengthen institutional; legal and regulatory frame work; promote variety development and seed production; enhance research in the potato industry; to increase potato production; improve post-harvest handling; value addition and marketing; promote public -private partnerships in the potato industry development and Improve funding to the potato industry. In the strategy, the potato processors (Sereni fries, Kentucky fried chicken, Njoro canners midlands, Norda, Propack, Deepa) have the core function within potato production of product development and value addition.
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	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days

	<ul style="list-style-type: none"> • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital platforms – Website, Dashboards, Apps, Social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of agricultural policies and specific Potato- based policies • Availability of policy goals, objectives and key areas of concerns
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding Potato policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Potato policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Poorly established potato value chain • Potato production are specific to agro-ecological zones and not all the Counties in Kenya grow Potato
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of producer organizations as an institution • Policies for increasing productivity • Sensitization of stakeholders • Strengthening potato value chain • Diversification of Potato
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Coordination of stakeholders
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Lack of awareness by farmers on the existing potato strategy • Environmental conditions – lack of a comprehensive land use • Policy • Market conditions - Poor market infrastructure

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Potatoes farmers especially women are unable to access production inputs such as certified cotton seed, fertilizers and agro –chemicals • In marketing of potato women and youth face exploitation from middle men because there are not aware of the policies guiding production and marketing of the products • Women are usually left out when key decisions are made relating to potato value chain • Women and youth lack access and control of productive resources such as land, equipment and credit facilities
Gender related opportunities	<ul style="list-style-type: none"> • Increased income for youth (female and male) • Increased employment for youth, (females and males)
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have no access to certified inputs such as seeds • VMGs are left out when key decisions are being made relating to cotton production and marketing • VMGs are not aware of existing agricultural policies especially relating to potatoes value chain due to limited access to agricultural information and extension
VMG related opportunities	<ul style="list-style-type: none"> • Supporting VMGs in the production and marketing of Potato. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Coordinated functions among the stakeholders in the potation production industry
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)	1. Ready for upscaling
G: Contacts	
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GAPS

- 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 Policy cycle

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	Low potato productivity due to lack of realization of benefits of the objectives of the potato strategy by the smallholder farmers. Without actualization of the objectives of the potato strategy, potato industry will remain under-developed, not coordinated and lack of functioning by the smallholder farmers. The institutional, legal and regulatory objective will remain unachieved.
What is it? (TIMP description)	The policy cycle detailed in the potato strategy includes sequential parts or stages. These are (1) problem emergence, (2) agenda setting, (3) consideration of policy options, (4) decision-making,, (5) implementation, and (6) evaluation. The cycle is a valuable device for involving the smallholder farmers of potato to articulate their issues in the potato production and marketing and therefore initiate the centralization of their agencies and voices.
Justification	Without the use of policy cycle, the potato strategy could not be complete and applicable. With the use of policy cycle, farmers analyzed the constraints, challenges and opportunities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Agripreneurs Extension, NGOs, Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents

	<ul style="list-style-type: none"> Farmer to farmer extension models Mass media – Electronic and print Publications - posters/brochures/leaflets, manuals Digital platforms – Website, Dashboards, Apps, Social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Availability of stakeholders Availability of agricultural policies and specific Potato-based policies Availability of policy goals, objectives and key areas of concerns
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Farmers – Demanding potato policies to support production and marketing County extension staff - Sensitization of farmers NGOs – Sensitization of farmers Private sector (local traders and exporters) – Demanding Potato policies to support production and marketing Research institutions – Sensitization of stakeholders
<ul style="list-style-type: none"> C: Current situation and future scaling up 	
Counties where already promoted if any	<ul style="list-style-type: none"> Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> Disorganization and scattered farmers Small-scale farming Inadequate information to stakeholders on the agricultural policies whether National or County Poorly established Potato value chain Potato production are specific to agro-ecological zones and not all the Counties in Kenya grow Potato
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Formation of producer organizations as an institution Policies for increasing productivity Sensitization of stakeholders strengthening potato value chain Diversification of Potato
Lessons learned in up scaling if any	<ul style="list-style-type: none"> The National Potato Strategy is available but the objectives are far from being achieved
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Social conditions – Institutions, legal and regulatory framework Environmental conditions – lack of a comprehensive land use policy Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600

Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth have limited access to education, training and extension services. • Women may not be able to travel away from their homes to attend trainings meetings, without permission so they are not able to participate in policy stakeholders meetings relating to agricultural production • Women are limited from participating in agricultural meetings as they lack finances to pay for transport if the meetings are held far from their localities • Women have less access to agricultural information, technology and knowledge • Potatoes farmers especially women are unable to access production inputs such as certified cotton seed, fertilizer and agro –chemicals • In marketing of potato women and youth face exploitation from middle men because there are not aware of the policies guiding production and marketing of the products • Women are usually left out when key decisions are made relating to potato value chain • Women and youth lack access and control of productive resources such as land, equipment and credit facilities • Policies relating to potatoes value chain should support youth, (females and males) in production and marketing of potatoes
Gender related opportunities	<ul style="list-style-type: none"> • There will be increased participation of all genders in potato production and marketing • Increased income by youth (female and male) • Increased employment for all genders at various nodes of potato value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have no access to certified inputs such as seeds • VMGs are left out when key decisions are being made relating to potato production and marketing • VMGs are not aware of existing agricultural policies especially relating to potatoes value chain due to limited access to agricultural information and extension
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased support of the VMGs in the production and marketing of Potato. • Increased income to VMGs • Increased employment to VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Promotion of participatory policy development in Counties
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	2-Requires validation
G: Contacts	
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Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock and Development (MOALD), International Potato Centre (CIP), • National Potato Council of Kenya (NPCK), • International Centre for Insect Physiology and Ecology (ICIPE), FAO, • Common Interest Groups (CIGs), • GIZ, • NGOs

GAPS

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

2.12.3 County Integrated Development Planning

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 potato productivity due to limited functional County Government roles as a stakeholder in the National Potato Strategy, for instance the provision of extension services, policy

	implementation, training of staff and farmers on technology transfer.
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 potato production, marketing and processing are considered. .
Justification	Without streamlining the National potato strategy, with the CIDP, the County as a stakeholder will not perform its function of providing quality extension services and participate in the formulation and implementation of agricultural policies potato being a priority.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, agripreneurs Extension, NGOs, Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital platforms – Website, Dashboards, Apps, Social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of County Integrated Development Plans • Levels of literacy among the smallholder farmers of potato. • Willingness of farmers to participate in the development of CIDP
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu

Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the CIDPs County
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of producer organizations as an institution • Policies for increasing productivity
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Farmers as stakeholders fail to articulate their issues in potato production and marketing • Monitoring and evaluation of CIDP is weak
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Weak institutions, literacy levels • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Potato policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Development and dissemination – Supporting youth, (females and) in production and marketing Potato • Adoption and scaling – Supporting youth, (females and males) in production and marketing Potato
Gender related opportunities	<ul style="list-style-type: none"> • . • Increased income by youth (female and male) • Increased employment by youth, (females and males)
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Development and dissemination – Low productivity and in access to markets by VMGs • Adoption and scaling up - Low productivity and in access to markets by VMGs
VMG related opportunities	<ul style="list-style-type: none"> • Supporting VMGs in the production and marketing of Potato.
	<ul style="list-style-type: none"> • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	A well planned integrated County development actions on potato, can enhance the implementation of the National potato strategy
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	1-Ready for upscaling


validation, 3. Requires further research)	
G: Contacts	
Contacts	The Centre Director KALRO-Tigoni P.O. Box 338-00217 Limuru, Kenya Telephone: 020 2023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
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Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock and Development (MOALD) • , International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE) • FAO • Common Interest Groups (CIGs) • GIZ • NGOs

GAPS

1. Adoption of policies
2. Equity distribution among the stakeholders
3. Productivity levels among the smallholder farmers due to CIDPs
4. Farmer accessibility to production inputs

2.12.4 Policy instruments for the producers of potato

TIMP Name	Policy instruments for the producers of potato
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low potato productivity due to non-functioning roles instruments in the National potato strategy.

	 <p>Extended bags of between 130 kg to 250kg</p>
What is it? (TIMP description)	<p>The policy instruments are the means to achieve the National potato policy objectives through stakeholders. Some of the instruments in the National Potato Strategy are provision of extension services, policy implementation, training of staff and farmers on technology transfer by the County governments. Other instruments through KALRO-Tigoni are development and dissemination of suitable technologies, provision of basic seed potato, research on pest and disease management, maintenance and supply of breeder's seed, disseminate research findings to the MOALD and other stakeholders and capacity building on seed production and marketing.</p>
Justification	<p>There are many stakeholders in the potato industry. The Potato industry is characterized by a few large scale farmers and many small scale farmers scattered in sixteen counties. Potato is traded in unstructured marketing systems where value addition is minimal at producer level despite the huge potential. The National policy instruments provide a road map for the industry players and to create opportunities to develop the industry by addressing identified constraints. The instruments are intended to harmonize the activities of different players and fully utilize their synergies and complementarities. Well implemented instruments result into not only a vibrant sub sector, but also very efficient utilization of the resources.</p>
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	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations – On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital platforms – Website, Dashboards, Apps, Social

	media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of policy instruments • Levels of literacy among the smallholder farmers of potato.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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	Nyandarua, Nyeri, Kiambu, Elgeyo Marakwet
Counties where TIMPs will be up scaled	Elgeyo Marakwet, Nyandarua, Nyeri, Taita Taveta, Bomet and Uasin Gishu
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inappropriate policy instruments
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • 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	For a successful implementation of the policy instruments, there is need to identify, mobilize and sensitize the stakeholders.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Literacy levels among the smallholder farmers of potato • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Potato policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Based on the County, the average basic costs of potato production per crop cycle per acre is Ksh. 127,600
Estimated returns	Depending on the potato variety, the potato farmer can earn a total return of Ksh.250, 000. The gross margin per acre Ksh. 122,400 per crop cycle, calculated after deducting total crop expenditures.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women might not have adequate information on the CIDP due to their low level of education • Women may not be able to travel away from their homes to producer group meetings, without permission limiting them chance of getting information • Women and youth are discriminated against when important decisions are being held relating to development at all levels

	<ul style="list-style-type: none"> • Women may not be able to travel away from their homes to attend trainings meetings, without permission so they are not able to participate in policy stakeholders meetings relating to agricultural production • Women are limited from participating in agricultural meetings as they lack finances to pay for transport if the meetings are held far from their localities • In marketing of potato women and youth face exploitation from middle men because there are not aware of the policies guiding production and marketing of the products even at the county level • Women are usually left out when key decisions are made starting from the household to the County level • Women and youth lack access and control of productive resources such as land, equipment and credit facilities • The county need to encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
Gender related opportunities	<ul style="list-style-type: none"> • There will be increased participation of all genders in potato production and marketing • Increased income by youth (female and male) • Increased employment for all genders at various nodes of potato value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are left out when key decisions are being made relating to production and marketing • VMGs are not aware of existing agricultural policies especially relating to potatoes value chain due to limited access to agricultural information and extension • VMGs are excluded from participating when important meetings and workshops are being held relating to agricultural information and dissemination • VMGs may not be able to travel away from their homes to attend trainings meetings, due to their physical challenges and also lack of finances to pay for their transport • VMGs have less access to agricultural information, technology and knowledge
VMG related opportunities	<ul style="list-style-type: none"> • There will be increased support of the VMGs in the production and marketing of Potato. • Increased income by VMGs • Increased employment by VMGs • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Some farmers in some potato growing Counties have started using the policy instruments
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)	1-Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Tigoni P.O. Box 338-00217 Limuru, Kenya Telephone: 0202-023213 Mobile: 0727031783 E-mail: kalro.tigoni@kalro.org
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Partner organizations	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock and Development (MOALD) • International Potato Centre (CIP) • National Potato Council of Kenya (NPCK) • International Centre for Insect Physiology and Ecology (ICIPE), FAO • Common Interest Groups (CIGs) • GIZ • NGOs

GAPS

1. Adoption of policy instruments
2. Equity distribution among the stakeholders
3. Farmer accessibility to production inputs
4. Improvement in potato output market



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