



# Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Onion 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**

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

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

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

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

## PREFACE

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

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

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

KALRO, having the responsibility of implementing the activities under Component 2, has been instrumental in using its information resources and those of partners and collaborators to come up with the inventories of TIMPs and corresponding ToT manuals. Use of these

information resources coupled with the accompanying training and contribution of the other project components will go a long way in enabling KCSAP to meet its development objectives.

The National Project Coordination Unit is grateful to all who participated in the development and production of this TIMPs inventory for Onion value chain. It is my hope that counties and other users will put this resource to good use as they transform and reorient their agricultural systems to make them more productive and resilient while minimizing GHG emissions under the new realities of the changing climate.

**Francis Muthami**  
**National Project Coordinator**  
**Kenya Climate-Smart Agriculture Project**

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## ABBREVIATIONS AND ACRONYMS

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

## 1.0 DEFINITION OF TERMS AND SUMMARY TABLES OF ONION TECHNOLOGIES, INNOVATIONS AND MANAGEMENT PRACTICES (TIMPS)

### 1.1 Definition of terms

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

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

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

### 1.2 Summary of Inventory of TIMPs in the onion Value Chain

The inventory process identified 75 TIMPs comprising 55 technologies, 4 innovations and 20 management practices, distributed among the Sub-themes, as indicated in the table 1.

*Table 1: Summary of onion TIMPs*

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Onion	Improved onion varieties	10	0	0
Onion	Onion seed system	1	0	0
Onion	GAPs and Food Safety	0	0	2
Onion	Agronomic management practices	0	0	1
Onion	Soil Fertility Management	0	1	3
Onion	Soil and Water Management	12	2	2
Onion	Onion Crop health	14	1	2
Onion	Postharvest management	3	0	3
Onion	Onion Value addition	3	1	0
Onion	Mechanization of Onion production activities	5	0	0
Onion	Onion business and Marketing	0	0	4
Onion	Agricultural Policy	0	0	4
<b>Total</b>		<b>51</b>	<b>4</b>	<b>20</b>

### 1.3 Summary of Status of TIMPs in Onion Value Chain

The inventory process resulted in a total of 55 TIMPs that are ready for up-scaling 14 TIMPs that require validation and 5 T

IMPs that require further research in the sub-themes, as indicated in Table 2.

*Table 2: Number of TIMPS ready for upscaling, require validation or further research*

<b>Commodity/VC</b>	<b>Sub-Theme</b>	<b>Ready for up-scaling</b>	<b>Require validation</b>	<b>Further Research</b>
Onion	Improved Onion varieties	10	0	0
Onion	Onion seed system	1	0	0
Onion	GAPs and Food Safety	2	0	0
Onion	Agronomic management practices	1	0	0
Onion	Soil Fertility Management	0	4	0
Onion	Soil and Water Management	11	3	1
Onion	Onion Crop health	16	1	0
Onion	Postharvest management	5	0	1
Onion	Onion Value addition	0	1	3
Onion	Mechanization of Onion production activities	5	0	0
Onion	Onion business and Marketing	4	1	0
Onion	Agricultural Policy	0	4	0
<b>Overall Total</b>		<b>55</b>	<b>14</b>	<b>5</b>

*Table 3: Inventory of Onion TIMPs by Category and Status*

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.1 Improved Onion varieties</b>	2.1.1 Red creole	Technology	Ready for upscaling
	2.1.2 Red couch F1	Technology	Ready for upscaling
	2.1.3 Jamber F1	Technology	Ready for upscaling
	2.1.4. Texas early Grano	Technology	Ready for upscaling
	2.1.5 Red Pinoy F1	Technology	Ready for upscaling
	2.1.6 Neptune F1	Technology	Ready for upscaling
	2.1.7 Bombay Red	Technology	Ready for upscaling
	2.1.8 Red Passion F1	Technology	Ready for upscaling
	2.1.9 Red Nice F1	Technology	Ready for upscaling
		2.1.10. Redstar F1	Technology
<b>2.2 Onion seed system</b>	2.2.1. Own seed selection	Management practice	Needs validation
	2.2.2. Informal Seed System	Management practice	Needs validation
	2.2.3. Formal Seed System	Technology	Ready for upscaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.3 Good Agricultural Practices and Food</b>	2.3.1 Good Agricultural Practices (GAP) for Onion	Management practice	Ready for upscaling

<b>Safety Management Systems</b>	2.3.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Onion Value Chain in Kenya	Management practice	Ready for upscaling
<b>2.4 Agronomic management practices</b>	2.4.1 Raising clean seedlings in the nursery	Management practice	Ready for upscaling
	2.4.2 Environmental friendly farming methods for improved production	Management practice	Requires validation
	2.4.3 Production by use of bucket drip irrigation	Management practice	Requires Validation
	2.4.4 Use of plants intercrops (carrots, spider plant and French bean) in control of pests	Management practice	Requires validation
	2.4.5 Use of black polythene paper in control of weeds	Management practice	Requires validation
	2.4.6 Use of grass as a mulch in weed control	Management practice	Ready for upscaling
	2.4.7. Harvesting at appropriate physiological stage	Management practice	Requires validation
<b>2.5 Soil fertility management</b>	2.5.1 Integrated Manure Management	Management Practice	Requires validation
	2.5.2 Integrated Soil Fertility Management (ISFM)	Management Practice	Requires validation
	2.5.3 Rapid soil testing services	Innovation	Requires validation
	2.5.4. Low cost composting	Management Practice	Requires validation
<b>2.6 Soil and water management</b>	2.6.1 Contour bands	Technology	Ready for upscaling
	2.6.2 <i>Zai</i> Pits	Technology	Ready for upscaling
	2.6.3 Bench terraces	Technology	Ready for upscaling
	2.6.4. <i>Fanya Juu</i> terraces	Technology	Requires validation
	2.6.5. Stone lines	Technology	Ready for upscaling
	2.6.6 Retention ditches	Technology	Ready for upscaling
	2.6.7 Grass strips	Technology	Ready for upscaling
	2.6.8 Tied ridges /Ridging /Earthing	Technology	Ready for upscaling
	2.6.9 Rain water harvesting systems (ponds and dams)	Management practice	Ready for up-scaling
	2.6.10 Conservation Agriculture (CA)	Management practice	Ready for up-scaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
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	2.6.11 Onion-legume intercropping	Technology	Requires further research
	2.6.12 Mulching	Technology	Requires further research
	2.6.13 Drip irrigation systems for small scale farmers	Technology	Ready for up-scaling
	2.6.14. Solar irrigation for smallholder farmers	Innovation	Requires validation
	2.6.15. Hydroponics	Innovation	Requires validation
	2.6.16. Agroforestry for soil fertility	Technology	Ready for upscaling
<b>2.7 Onion Crop Health</b>	2.7.1 Integrated management of cutworms	Management practice	Ready for up-scaling
	2.7.2 Integration management of onion thrips	Management practice	Ready for up-scaling
	2.7.3 Integrated management of onion fly	Management practice	Ready for up-scaling
	2.7.4 Integrated management of aphids	Management practice	Ready for up-scaling
	2.7.5 Integrated management of leafminer	Management practice	Ready for up-scaling
	2.7.6 Integrated management of onion root knot nematodes	Management practice	Ready for up-scaling
	2.7.7 Management of Pink rot in onions	Management practice	Ready for up-scaling
	2.7.8. Integrated management of downy mildew	Management practice	Ready for upscaling
	2.7.9. Integrated management of purple blotch disease of onion	Management practice	Ready for upscaling
	2.7.10. Integrated management of Xanthomonas leaf blight	Management practice	Ready for upscaling
	2.7.11. Integrated weed management	Innovation	Ready for up-scaling
	2.7.12. Herbicides for weed control in onion	Technology	Ready for upscaling
	2.7.13. Weed management by intercropping in onion	Innovation	Requires validation
	2.7.14. Use of mulch for weed management in onion	Technology	Ready for upscaling
	2.7.15. Mechanical weeding	Technology	Ready for upscaling
		2.7.16. Safe use of herbicides	Management

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
		practice	
<b>2.8 Harvest and Postharvest management</b>	2.8.1 Harvesting of onions	Management Practice	Ready for up-scaling
	2.8.2. Curing of onions	Technology	Ready for up-scaling
	2.8.3. Onion storage	Technology	Requires further research
	2.8.4. Control of fungal and bacterial rots in onions	Management practice	Ready for up-scaling
	2.8.5. Sorting and grading	Management Practice	Ready for up-scaling
	2.8.6. Packaging of onions	Technology	Ready for upscaling
<b>2.9 Onion Value Addition</b>	2.9.1. Dehydrated onions (flakes and powder)	Technology	Requires validation
	2.9.2. Pickled onions	Technology	Requires further research
	2.9.3. Essential oils	Technology	Requires further research
	2.9.4. Onion wine	Innovation	Requires further research
<b>2.10 Mechanization of Onion production activities</b>	2.10.1. Power Tiller	Technology	Ready for upscaling
	2.10.2 Four wheel tractor	Technology	Ready for up-scaling
	2.10.3 Mouldboard Plough	Technology	Ready for up-scaling
	2.10.4. Harrow	Technology	Ready for up-scaling
	2.10.5. Motorised Sprayer	Technology	Ready for upscaling
<b>2.11 Business and marketing</b>	2.11.1 Models for organizing farmer groups	Management practices	Ready for upscaling
	2.11.2. Developing a business plan	Management practices	Ready for upscaling
	2.11.3 Marketing as a group - collective marketing	Management practices	Ready for upscaling
	2.11.4 Reviewing onion agroenterprise performance – Profitability analysis	Management practices	Ready for upscaling
	2.11.5 Scaling up plan	Management practices	Requires validation;
<b>2.12. Agricultural Policy options</b>	2.12.1 Policy options and objectives related to onion farming	Management practices	Ready for upscaling
	2.12.2 Instruments of Policy related to onions	Management practices	Ready for upscaling
	2.12.3 Policy cycle for formulation and implementation of	Management practices	Requires validation


<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	policies		

	2.12.4 Policy validation cycle for stakeholders' participation	Management practices	Ready for upscaling
	<b>Total TIMPs</b>		

## 2.0 DETAILED ONION VALUE CHAIN TIMPS

**Figure 1: Suitability map of Onion in Kenya**


### 2.1 Onion Varieties

2.1.1 TIMP Name		Onion variety	Red Creole
Category (i.e. technology, innovation or management practice)		Technology	
<b>A: Description of the technology, innovation or management practice</b>			
Problem to be addressed		Low yields due to limited availability of onion varieties responsive to changes associated with climate change such as increased ambient temperatures, reduced rainfall, changes in rainfall patterns and pest and disease emergence.	
What is it? (TIMP description)		<p>Red Creole is a medium maturing variety (4 months), and a high yielder (20-25 t/acre), tolerant to pink rot disease and drought. It does well in low altitude areas with full sun and minimal rainfall. The bulbs are small to medium size with a shelf life of up to six months.</p> 	
Justification		As a high yielder (20-25 t/acre), resistance to pink rot disease and drought, Red creole variety is a good bet for farmers faced with the challenges of pink rot disease and drought. Moreover, the long shelf life (6 months) and medium bulb size makes it a good bet for retail trade.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>			
Users of TIMP		Farmers, Seed producers, seedling raisers, researchers, extension service providers	
Approaches to be used in dissemination		<ul style="list-style-type: none"> <li>• Onion Innovation Platforms</li> <li>• Onion Farmer Field and Business Schools</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Farmer field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programmes</li> </ul>	

	<ul style="list-style-type: none"> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Websites</li> <li>• Social media such as WhatsApp</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Preferred traits by farmers</li> <li>• Promotion methods used</li> <li>• Involvement of all onion stakeholders in the promotion chain</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>• National and County Departments of Agriculture to coordinate extension services and policies</li> <li>• KEPHIS to monitor seed quality</li> <li>• Seed merchants to distribute quality seed</li> <li>• Farmers to participate in trainings and offer demonstration plots</li> <li>• Seed companies for quality seed production and distribution</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions.</li> </ul>
<b>C. Current and future scaling up</b>	
Counties where already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	West Pokot, Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited information on harvest and post-harvest practices</li> <li>• Lack of varietal information</li> <li>• High cost of farm inputs</li> <li>• Limited availability of irrigation water</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Provide all necessary information</li> <li>• Capacity build on post-harvest practices e.g culling and drying</li> <li>• Lobby for Government subsidy on farm inputs</li> <li>• Capacity build growers on water use efficiency</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Organizing farmers into grower groups</li> <li>• Introduce natural resource management methods in the dissemination fora</li> </ul>

	<ul style="list-style-type: none"> <li>• Policy on to reduce imports from neighboring countries</li> <li>• Institute organized marketing systems like aggregation</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Approximately KES 150 000 per acre</li> </ul>
Estimated returns	25000kg/acre@40 per Kg farm gate=KES 1,000,000 less 150,000=KES 750,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for onion cultivation than men</li> <li>• Women and youth may have limited access to finances to buy the required inputs such as quality seeds</li> <li>• Women perform most of the transplanting and weeding activities.</li> <li>• The technology may increase their labor burden hence fail to be adopted</li> <li>• Women may not have time and mobility to attend activities held far from home or at times when they are performing other domestic chores.</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic chores.</li> <li>• Encourage women and youth to hire land</li> <li>• Involve women and youth in capacity building activities</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Introduction of labour intensive tools such as the weeder will reduce women's work burden</li> <li>• Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land</li> <li>• VMGs may have limited access to finances to buy the required inputs Women have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>• Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs</li> <li>• Introduction of labour intensive tools such as the weeder will</li> </ul>

	<p>reduce the labor burden of VMGs such as the elderly and those abled differently.</p> <ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case Studies/ Profile of success stories</b>	
Success stories	<p><b>Successful Case Study: Embaringo Onion Innovation Platform</b></p> <p>Embaringo innovation platform was initiated in 2010 in Kieni Sub County of Nyeri County to address various onion production and marketing challenges. The innovation platform revolutionized farming in the area by increasing yields from 3 tons to 14 tons and significantly increased onion acreage. Onion production per farmer increased from 15 to 30 tonnes per person per year. Land prices in the area increased while the youth were attracted to onion production as a business.</p>
<b>F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	<p>The Institute Director  Horticulture Research Institute  P.O. Box 220-01000, Thika  Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a></p>
Lead organization and scientists	<p>KALRO  Rebecca Faaray, M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L., Willis Owino</p>
Partner organizations	<ul style="list-style-type: none"> <li>• Jomo Kenyatta University of Agriculture and Technology</li> <li>• National and County Government Ministry of Agriculture, Livestock, Fisheries and Irrigation Services</li> <li>• Egerton University</li> <li>• CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>

<b>2.1.2. TIMP Name</b>	<b>Onion variety: Red Couch F1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to limited availability of varieties that respond to changes associated with climate change such as increased ambient temperatures, reduced rainfall, changes in rainfall patterns, pest and disease emergence.
What is it? (TIMP description)	<p>Red Couch F1 is resistant to pink rot disease, is early maturing (3 months after transplanting) and yields 20-30t/acre.</p> 
Justification	Due to its resistance to pink rot disease, high yields and early maturity, onion variety Red Couch F1 is a good bet for farmers in areas where soils are infested with the pink rot causing pathogen. Moreover, the early maturity attribute leads to reduction in cost of production.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion Farmers, producer groups, seed dealers, researchers, Extension service providers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm and on station research trials and demonstrations</li> <li>● Agricultural innovation platforms</li> <li>● Training workshops, Seminars, Meetings</li> <li>● Field days, open days, model farm visits</li> <li>● Agricultural shows</li> <li>● MoA/Extension officers</li> <li>● Farmer research networks</li> <li>● Mass media – Agricultural programmes</li> <li>● Promotional materials (posters/brochures/leaflets, manuals)</li> <li>● Websites</li> </ul>

	<ul style="list-style-type: none"> <li>● Social media (WhatsApp, Facebook, Twitter, Instagram)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Seed availability and accessibility</li> <li>● Good seed system to ensure quality</li> <li>● Diversification of onion consumption through value addition</li> <li>● Organized farmer groups and networks</li> <li>● Good Marketing Models and pathways</li> <li>● National and county government support</li> <li>● Funding to research, validate and promote new onion varieties</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>● National and County Governments, (Formal and informal) for policy, awareness and dissemination</li> <li>● Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>● The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> <li>● NGOs to take up Onion for farmer organizing and mobilization</li> <li>● Seed companies for quality seed production and distribution</li> <li>● Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current and future up scaling</b>	
Counties where already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	West Pokot, Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Labour intensity in planting and weeding</li> <li>● Unorganized marketing channels</li> <li>● The perception that seed is expensive</li> <li>● Limited availability of seed</li> <li>● Absence of grower and common interest groups</li> <li>● Lack of policy that support onion crop growing and marketing</li> <li>● Limited information on harvest, post-harvest and value addition</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Formation of grower groups</li> <li>● Inclusion of other stakeholders (Seed Companies, agro-dealers, County Governments, marketers) in the activities</li> <li>● Mechanization of onion production to reduce labour</li> </ul>


	<p>problems</p> <ul style="list-style-type: none"> <li>● Promote marketing models that encourage collective production and marketing</li> </ul>
	<ul style="list-style-type: none"> <li>● Develop good policy for the Onion crop</li> <li>● Involve County governments, extension, marketers and processors</li> <li>● Promote value addition and consumption in local food systems</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties</li> <li>● Availability of market is important</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on nutritive value of the variety.</li> <li>● Harmonious gender consideration in research, consumption and marketing.</li> <li>● Inclusion of women, youth and VMGs</li> <li>● Improvement of marketing structure</li> <li>● Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000.
Estimated returns	40*25,000=KES 1,200,000 less average cost of production which is KES. 150,000 per Acre = KES 750,000 Net Income. *Farm gate price per kg
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation</li> <li>● Women and youth may also have limited access to finances to buy the required inputs</li> <li>● Women perform most of the transplanting and weeding activities.</li> <li>● The crop may increase their labour burden leading to limited adoption</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic chores.</li> <li>● Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic chores</li> <li>● The technology may not be adopted if the gender targeted especially women is overburdened</li> <li>● The technology is acceptable and easy to upscale by both men and women</li> <li>● Women may not have time and mobility to attend extension activities far from home or held at times when they have other chores</li> <li>● Women may experience difficulty in acquiring land for successful onion production.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> </ul>

	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> <li>• Women and youth are the main retailers of onion</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may have limited access to finances to buy the required inputs Women have less access to agricultural information, technology and knowledge</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to education, training and extension services</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>• Increased production will lead to increased consumption and utilization of nutritious onions, hence improved health of VMGs.</li> <li>• Introduction of labour-intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>• Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>

**E: Case studies/profile of success stories**

Success stories	None
<b>F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
	Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead Organization and Scientists	KALRO Rebecca Faaray, Jesca Mbaka, Vincent Ochieng, Charity Gathambiri, Lusike Wasilwa and Violet Kirigua

<b>2.1.3 TIMP name</b>	<b>Onion variety: Jambar F1</b>
Category (i.e. technology,	Technology


innovation or management practice)	
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to limited availability of varieties with attributes responsive to climate change such as increased temperatures, erratic, insufficient rainfall, upsurge of incidence of pests and diseases.
What is it? (TIMP description)	Jambar F1 matures in 90 days after transplanting, has a yield potential of 25t/acre, easily cures and dries well in the farm and a shelf life of 6 months. 
Justification	The short maturity period, long shelf life and high yields make Jambar F1 a good bet for farmers as the cost of production is low and the variety is preferred by traders in the retail segment of the marketing chain.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion farmers and producer groups
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm demonstrations</li> <li>• Field/open days, Farmer field schools</li> <li>• Agricultural shows and farmer learning tours</li> <li>• Distribution of publicity material (brochures, fact sheets, pamphlets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Timely availability of quality seeds</li> <li>• Training of trainers</li> <li>• Favourable weather and provision of supplementary irrigation.</li> <li>• Involvement of all value chain players</li> <li>• Market demand for the produce.</li> </ul>
Partners/stakeholders for scaling up their roles and stage of involvement	<ul style="list-style-type: none"> <li>• KALRO- Conducts on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>• Farmers-To participate and provide land for demonstration plots and labour</li> <li>• National and County Ministry of Agriculture, Livestock and Fisheries-Technical advisory and extension service, Farmer mobilization, policy formulation and enforcement</li> <li>• NGOs/CBOs-Farmer recruitment and mobilization, Capacity building, M&amp;E</li> <li>• Farm input suppliers- Provision of the seed, fertilizers, pest</li> </ul>

	control products
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate/unavailability of seed</li> <li>• Erratic weather patterns due to climate change</li> <li>• Inadequate funds to purchase seeds</li> <li>• Inadequate varietal information</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Provision of seeds</li> <li>• Collaboration seed companies for supply of seed</li> <li>• Capacity building of farmers and service providers in production</li> <li>• Provision of varietal information to allow choice</li> </ul>
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>• Working with partners with comparative advantage ensures success of the project</li> <li>• Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>• Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Onion is socially acceptable and any technology to increase its production will be readily adopted.</li> <li>• Existence of suitable bio-physical environments in target counties.</li> <li>• Availability of domestic and regional markets for the commodity.</li> <li>• Availability of policies that facilitate easy movement of onion produce from farms to markets in the region.</li> </ul>
<b>C. Current and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Erratic weather patterns due to climate change</li> <li>• Inadequate funds to purchase seeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Capacity build on post-harvest practices e.g culling and drying</li> <li>• Lobby for Government subsidy on farm inputs</li> <li>• Capacity build growers on water use efficiency and ability to use weather data</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Chances of successful up scaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties</li> </ul> <p>Availability of market is key</p>

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Organizing farmers into grower groups</li> <li>● Introduce natural resource management methods in the dissemination fora</li> <li>● Policy on organized marketing systems like aggregation</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000.
Estimated returns	40*25,000=KES 1,000,000 less average cost of production which is KES. 150,000 per Acre = Ksh. 850,000 Net Income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth may also have limited access to finances to buy the required inputs such as quality seeds than men.</li> <li>● Women perform most of the transplanting and weeding activities. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted.</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic roles.</li> <li>● Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>● Introduction of labour-intensive tools such as the weeder will</li> </ul>

	<p>reduce the labor burden of VMGs such as the elderly and those abled differently.</p> <ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	Director Horticulture Research Institute, P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	KALRO : J. Mbaka, R. Faaray, M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L.
Partner organizations	<ul style="list-style-type: none"> <li>• National and County Ministry of Agriculture, Livestock and Fisheries</li> <li>• Egerton University</li> <li>• CBOs and NGOs (Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>


<b>2.1.4. TIMP name</b>	<b>Onion variety: Texas Early Grano</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield losses due to pink rot disease and post-harvest rots, limited adaptation to diverse climates, short shelf life
What is it? (TIMP description)	Texas Early Grano open pollinated, adapted to diverse agro-ecological zones, with resistance to pink rot and a shelf life of up to 4 months. The bulbs are small with a yield of 20t/acre.

		
Justification	Resistance to pink rot disease and adaptability to a wide range of agro-ecological zones makes Texas Early Grano a good bet to farmers in different agro ecological zones with soils infested with the pink rot disease pathogen. The long shelf life and small bulb size makes it ideal for retail trade which is the target market.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Seed growers, onion growers, farmer producer groups, onion traders	
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstrations</li> <li>● Farmer field days</li> <li>● Farmer to farmer extension</li> <li>● Agricultural shows and farmer learning tours</li> <li>● Agriculture innovation platforms</li> <li>● Digital platforms</li> </ul>	
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Timely availability of planting materials</li> <li>● Training of trainers</li> <li>● Favourable weather and provision of supplementary irrigation</li> <li>● Market demand</li> <li>● Available appropriate traits</li> </ul>	
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>● National and County Governments, e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>● Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>● The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> </ul>	

	<ul style="list-style-type: none"> <li>● NGOs to take up Onion for farmer organizing and mobilization</li> <li>● Seed companies for quality seed production and distribution</li> <li>● Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Inadequate/unavailability of high yielding varieties</li> <li>● Erratic weather patterns due to climate change</li> <li>● Inadequate funds to purchase seeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Provision of high yielding seeds</li> <li>● Capacity build farmers use of water resource and weather data to counter climate change</li> <li>● Collaboration with county government for subsidized seeds</li> <li>● Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>● Working with partners with comparative advantage will ensure success of the project</li> <li>● Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>● Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>● Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Onion is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place</li> <li>● Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> <li>● Existence of suitable bio-physical environments in target counties.</li> <li>● Availability of domestic and regional markets for the commodity.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000
Estimated returns	40*20,000=KES 800,000 less average cost of production which is KES 150,000 per Acre = KES 650,000 Net Income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation</li> <li>● Women and youth may have limited access to finances to buy the required inputs</li> </ul>

	<ul style="list-style-type: none"> <li>● Women perform most of the transplanting and weeding activities.</li> <li>● The roles may increase their labour burden leading to low adoption</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic chores.</li> <li>● Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic chores.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labor intensive tools such as the weeder will reduce women’s work burden.</li> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths’ funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>● Introduction of labour intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling

Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Contacts	
Lead organization and scientists	KALRO J. Mbaka, R.Faaray, M. Waiganjo, V. Ochieng, F. Wayua and Wasilwa L.
Partner organizations	<ul style="list-style-type: none"> <li>● National and County Ministry of Agriculture, Livestock and Fisheries</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● JKUAT</li> </ul>

<b>2.1.5 TIMP name</b>	<b>Onion variety: Red Pinoy</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Few varieties with attributes to respond to climate change effects such as increased temperatures, upsurge of pre and post-harvest pests and diseases, erratic rainfall and drought.
What is it? (TIMP description)	<p>Red Pinoy is an early maturing open pollinated variety with small bulbs, adapted to diverse agro-ecological zones, yield potential of 25-30 tons and shelf life of up to six months. The variety is resistant to downy mildew and purple blotch.</p> 

Justification	Adaptation to wide agro-ecological zones, early maturity, resistance to downy mildew and purple blotch, high yielding. Red Pinoy is a good bet for farmers in different agro ecological zones where purple blotch and downy mildew are prevalent. The long shelf life and small bulbs make it a good choice for traders in the retail sector of the marketing chain.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion growers, Farmer producer groups
Approaches to be used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows, agricultural innovation platforms, digital platforms and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	Farmers to provide demonstration farms, labour and other inputs
	<ul style="list-style-type: none"> <li>● County agricultural extension officers- To mobilize farmers, participate in training of trainers and FFS</li> <li>● KALRO-To establish on farm trials and demonstration plots</li> <li>● NGOs and CBOs-For farmer recruitment and mobilization, capacity building and M&amp;EaSeed Companies and agro dealers- to provide farm inputs (seed, fertilizers, pesticides)</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Erratic weather patterns due to climate change</li> <li>● Inadequate funds to purchase seeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Collaboration with seed companies for provision of fairly priced seeds</li> <li>● Capacity building of farmers knowledge in water use and weather data</li> </ul>

Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>● Working with partners with comparative advantage will ensure success of the project</li> <li>● Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>● Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>● Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Onion is socially acceptable and any technology to increase its production will be readily adopted.</li> <li>● Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> </ul>
	<ul style="list-style-type: none"> <li>● Existence of suitable bio-physical environments in target counties.</li> <li>● Availability of domestic and regional markets for the commodity.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000.
Estimated returns	1 kg of onions at the market price goes for an average of KES 60 hence $60 \times 20,000 = \text{KES } 1,200,000$ less average cost of production which is Ksh. 150,000 per Acre = Ksh. 1,150,000 Net Income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth may also have limited access to finances to buy the required inputs such as quality seeds than men.</li> <li>● Women perform most of the transplanting and weeding activities. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted.</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic roles.</li> <li>● Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles.</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>● Introduction of labour intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>

Lead organization and scientists	KALRO-Thika, Jesca Mbaka, Rebecca Faaray, Muguga, Kibos (Horticulture), Kakamega <ul style="list-style-type: none"> <li>• M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L., Willis Owino</li> </ul> JKUAT
Partner organizations	<ul style="list-style-type: none"> <li>• Ministry of Agriculture (County Governments)</li> <li>• Egerton University</li> <li>• CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>


<b>2.1.6. TIMP</b>	<b>Onion variety: Neptune F1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due insufficient rainfall, pink rot disease and post-harvest losses
What is it? (TIMP description)	Neptune F1 is drought tolerant, resistant to pink rot disease, is early maturing, and has a long shelf life. <div> </div>
Justification	Neptune F1 is a good bet for farmers in low rainfall areas due to its drought tolerance, and early maturity. Resistance to pink rot disease makes a good choice in areas with soils infested with the pink rot disease pathogen.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion seed producers, onion farmers producer groups, onion traders and input suppliers
Approaches to be used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, digital platforms, agricultural innovation platforms, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up and	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes</li> </ul>

their roles	<p>(NARIs) and academic institutions to validate management practices.</p> <ul style="list-style-type: none"> <li>• National and County Governments, e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>• The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> <li>• NGOs to take up Onion for farmer organizing and mobilization</li> <li>• Seed companies for quality seed production and distribution</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Erratic weather patterns due to climate change</li> <li>• Inadequate funds to purchase seeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Collaboration with county government subsidized/ fairly-priced seeds</li> <li>• Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>• Working with partners with comparative advantage ensures success of the project</li> <li>• Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>• Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>• Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Onion is socially acceptable and any technology to increase its production will be readily adopted.</li> <li>• Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> <li>• Existence of suitable bio-physical environments in target counties.</li> <li>• Availability of domestic and regional markets for the</li> </ul>

	commodity.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000.
Estimated returns	40*20,000=KES 800,000 less average KES 650,000 return
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth may also have limited access to finances to buy the required inputs such as quality seeds than men.</li> <li>● Women perform most of the transplanting and weeding activities. Therefore, the crop may increase their labour burden. This may lead to the technology not to be adopted.</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic roles.</li> <li>● Women have limited access to markets as they sometimes cannot travel to distant markets due to their domestic roles.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> </ul>

	<ul style="list-style-type: none"> <li>● Introduction of labor intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	KALRO J. Mbaka, R.Faaray, M. Waiganjo, V. Ochieng, F. Wayua and Wasilwa L.
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture and County Government Agriculture departments</li> </ul>
	<ul style="list-style-type: none"> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>

<b>2.1.7.TIMP name</b>	<b>Bombay Red</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield losses due to the Iris Yellow Spot virus disease, post-harvest losses due to poor curing, short shelf life, increased use of pesticides for management of thrips
What is it? (TIMP description)	Bombay Red is suited to diverse agro- climate zones. The neck dries easily leading to proper curing, long shelf life and easy packaging and transportation.

		
Justification	Bombay red has relative resistance to Iris Yellow Spot Virus disease. This is due to the glossy green colour and erect shape of its leaves that deters thrip infestation. Since thrips are the vectors of the virus disease, their deterrence leads to disease resistance. Moreover the use of pesticides for thrip control is reduced leading to increased profits.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Onion growers, Farmer producer groups	
Approaches to be used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours	
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation and market demand	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Onion growers, Farmer producer groups	
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows, digital platforms, agricultural innovation platforms and farmer learning tours	
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation and market demand	
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>• National and County Governments, e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>• The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> <li>• NGOs to take up Onion for farmer organizing and mobilization</li> <li>• Seed companies for quality seed production and distribution</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>	
<b>C: Current situation and future scaling up</b>		
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok	

Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Inadequate/unavailability of high yielding varieties</li> <li>● Erratic weather patterns due to climate change</li> <li>● Inadequate funds to purchase seeds</li> </ul>
Suggestions for Addressing the challenges	<ul style="list-style-type: none"> <li>● Enhance farmers capacity in water management and weather data use</li> <li>● Collaboration with county government of of subsidized/fairly priced seeds</li> <li>● Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up- scaling if any	<ul style="list-style-type: none"> <li>● Working with partners with comparative advantage will ensures success of the project</li> <li>● Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>● Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>● Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Onion is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place</li> <li>● Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> <li>● Existence of suitable bio-physical environments in target counties.</li> <li>● Availability of domestic and regional markets for the commodity.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The production cost per acre of onion is estimated at KES 150,000. After three months of transplanting the onions it can produce a yield of 20,000kgs bulb
Estimated returns	1 kg of onions at the market price goes for an average of KES 60 hence $60 \times 20,000 = \text{KES } 1,200,000$ less average cost of production which is Ksh. 150,000 per Acre = Ksh. 1,150,000 Net Income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth may also have limited access to finances to buy the required inputs such as quality seeds than men.</li> <li>● Women perform most of the transplanting and weeding activities. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted.</li> <li>● Women may not have time and mobility to attend training and other extension activities far from home or held at times when they are performing other domestic roles.</li> <li>● Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles.</li> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> </ul>

	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>● Introduction of labor intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>


**E: Case studies/profiles of success stories**

Success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015

**G: Contacts**

Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT</li> <li>● KALRO-Thika, Muguga, Kibos (Horticulture), Kakamega</li> <li>● M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L., Willis Owino</li> </ul>

Partner organizations	<ul style="list-style-type: none"> <li>• Ministry of Agriculture (County Governments)</li> <li>• Egerton University</li> <li>• CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>
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<b>2.1.8.TIMP name</b>	
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield losses due to pink rot and purple blotch diseases. High post-harvest losses due rotting caused by poor curing.
What is it? (TIMP description)	<p>Red Passion F1 variety is a hybrid variety with medium sized deep red bulbs, suited to low and medium altitude areas, with excellent curing and storage. The variety is resistant to pink rot and purple blotch.</p> 
Justification	<p>Pink rot and pulp blotch may lead to 50% yield loss in onion. Losses of up to 75% due to post harvest rots have been reported. There is a need for superior varieties with good curing and storage attributes to reduce post harvest losses. Fungicides used in the management of fungal diseases such as pink rot and purple blotch are greatly reduced when resistant varieties are grown. This makes the onion variety Red passion suitable. Moreover, it matures 90 days after transplanting and is preferred in the market.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion growers, farmer producer groups, seed growers, farmput suppliers
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows, media digital platforms, agricultural innovation platforms and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation and market demand
Partners/stakeholders for scaling up and their	<b>Farmers</b>

roles	<ul style="list-style-type: none"> <li>● In-kind contribution of labour, human capital, land for demonstration plots</li> <li>● Responsible for day to day management of trials</li> <li>● Participate in trial evaluation and up-scaling</li> <li>● Keep production records which will assist in M&amp;E</li> </ul> <p>Assisted in up-scaling of developed technologies i.e. lead farmers as trainers of trainers (ToT)</p>
	<p><b>County Agricultural extension officers</b></p> <ul style="list-style-type: none"> <li>● Service</li> <li>● Farmer mobilization</li> <li>● Capacity building of farmers</li> <li>● Assist in dissemination of technology and take leading role in up-scaling. Policy formulation and enforcement</li> </ul> <p><b>Researchers</b></p> <p>Establishment of demonstration plots and coordinate farmer trainings Conducts on-farm research, capacity building of county stakeholders, extension workers and farmers</p> <p><b>NGOs and CBOs</b></p> <ul style="list-style-type: none"> <li>● Farmer recruitment and mobilisation</li> <li>● Capacity building</li> <li>● M&amp;E</li> </ul> <p>Assisting in up-scaling of technology</p> <p><b>Farm input suppliers</b></p> <p>Provision of seed, fertilizers and pest control products</p>
<b>C: Current situation and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Inadequate/unavailability of high yielding varieties</li> <li>● Erratic weather patterns due to climate change</li> <li>● Inadequate funds to purchase seeds</li> </ul>
Suggestions for Addressing the challenges	<ul style="list-style-type: none"> <li>● Enhancing capacity for farmers in water management and weather data use to counter climate change</li> <li>● Collaboration with county government of seed material</li> <li>● Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>● Working with partners with comparative advantage will ensures success of the project</li> </ul>

	<ul style="list-style-type: none"> <li>● Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>● Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>● Availability of gross margin information enhances adoption of technology.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Onion is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place</li> <li>● Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> <li>● Existence of suitable bio-physical environments in target counties.</li> <li>● Availability of domestic and regional markets for the commodity.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The production cost per acre of onion is estimated at KES 150,000. After three months of transplanting the onions it can produce a yield of 20,000kgs bulb
Estimated returns	1 kg of onions at the market price goes for an average of KES 60 hence $60 \times 20,000 = \text{KES } 1,200,000$ less average cost of production which is Ksh. 150,000 per Acre = Ksh. 1,150,000 net income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● The technology may not be adopted if the gender targeted especially women is overburdened</li> <li>● The technology is acceptable and easy to upscale by both males and females.</li> <li>● Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles</li> <li>● Women may experience difficulty in acquiring land for successful onion production.</li> <li>● Women usually work in collaboration with their husbands for easy access to land allocations for onion production.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> <li>● Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> </ul>

	<ul style="list-style-type: none"> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>● Introduction of labor intensive tools such as the weeder will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT</li> <li>● KALRO-Thika, Muguga, Kibos (Horticulture), Kakamega</li> <li>● M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L., Willis Owino</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>


<b>2.1.9.TIMP name</b>	<b>Red Nice F1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Few onion varieties with a wide climatic adaptation. Yield losses due to post harvest rotting caused by poor curing. Yield losses purple blotch disease.
What is it? (TIMP)	Onion variety Red nice F1 is a hybrid variety with small sized deep red bulbs, suited diverse agroecological zones, with excellent curing

description)	<p>and storage. The variety is resistant to purple blotch.</p> 
Justification	<p>Pulp blotch disease may lead to 40% yield loss in onion. Losses of up to 75% due to post harvest rots have been reported. There is need for superior varieties with good curing and storage attributes to reduce post-harvest losses. Fungicides used in the management of fungal diseases such as pink rot and purple blotch are greatly reduced when resistant varieties are grown. This makes the onion variety Red Nice F1 suitable. Moreover, the small bulb size is preferred in the market by retailers who may desire to sell per piece.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion seed growers, onion growers, farmer producer groups, onion traders and farm input suppliers
Approaches to be used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows, digital platforms, agricultural innovation platforms and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation and market demand
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>• National and County Governments, e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>• The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> <li>• NGOs to take up Onion for farmer organizing and mobilization</li> <li>• Seed companies for quality seed production and distribution</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Inadequate/unavailability of high yielding varieties</li> <li>● Erratic weather patterns due to climate change</li> <li>● Inadequate funds to purchase seeds</li> </ul>
Suggestions for Addressing the challenges	<ul style="list-style-type: none"> <li>● Enhance farmer's capacity in water management and weather data use to counter climate change</li> <li>● Collaboration with county government subsidized/fairly priced seeds</li> <li>● Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up-scaling if any	<ul style="list-style-type: none"> <li>● Working with partners with comparative advantage will ensures success of the project</li> <li>● Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>● Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>● Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Onion is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place</li> <li>● Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased uptake.</li> <li>● Existence of suitable bio-physical environments in target counties.</li> <li>● Availability of domestic and regional markets for the commodity.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The production cost per acre of onion is estimated at KES 150,000. After three months of transplanting the onions it can produce a yield of 20,000 kgs bulb
Estimated returns	1 kg of onions at the market price goes for an average of KES 60 hence $60 \times 20,000 = \text{KES } 1,200,000$ less average cost of production which is KES. 150,000 per Acre = KES. 1,150,000 Net Income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● The technology is acceptable and easy to upscale by both males and females.</li> <li>● Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles</li> </ul>

	<ul style="list-style-type: none"> <li>• Women may experience difficulty in acquiring land for successful onion production.</li> <li>• Women usually work in collaboration with their husbands for easy access to land allocations for onion production.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Introduction of labour intensive tools such as the weeder will reduce women's work burden.</li> <li>• Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for onion cultivation than men.</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>• Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>• Introduction of labor intensive tools such as the weeder will reduce the labour burden of VMGs such as the elderly and those abled differently.</li> <li>• Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute

	P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT</li> <li>● KALRO-Thika, Muguga, Kibos (Horticulture), Kakamega</li> <li>● M. Waiganjo, V. Ochieng, F. Wayua, Wasilwa L., Willis Owino</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>

<b>2.1.10.TIMP name</b>	<b>Redstar F1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to diseases such as downy mildew, pink rot and purple blotch
What is it? (TIMP description)	<p>Redstar F1 is a high yielding variety (25-30 t/acre), resistant to downy mildew, pink rot and purple blotch. The variety is suited to a wide range of agro-ecological zones, with excellent curing and shelf life of 4 months.</p> 
Justification	Being a high yielder (25-30t/acre) with resistance to downy mildew, purple blotch and pink rot, Red star F1 is a good bet for farmers in areas where the three diseases cause crop losses. More over the reduced use of fungicides reduces the effect on the environment.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion growers, farmer producer groups, farm input suppliers, seed produces, onion traders
Approaches to be used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows, digital platform, agricultural platforms, media, farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation and market demand

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and academic institutions to validate management practices.</li> <li>• National and County Governments, e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Farmers to provide human capital, land for demonstration plots, be responsible for day to day management of trials, participate in trial evaluation and up scaling of developed technologies keep production records to be used in monitoring and evaluation</li> <li>• The farmers are assisted in up scaling of developed technologies i.e lead farmers as trainers of trainers (ToT).</li> <li>• NGOs to take up Onion for farmer organizing and mobilization</li> <li>• Seed companies for quality seed production and distribution</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties already promoted if any	West Pokot, Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	West Pokot Bungoma, Taita Taveta, Kirinyaga, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate/unavailability of high yielding varieties</li> <li>• Erratic weather patterns due to climate change</li> <li>• Inadequate funds to purchase seeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Enhance farmers capacity in water management and weather data in countering climate change</li> <li>• Collaboration with county government for subsidized/ fairly priced seed</li> <li>• Capacity building of farmers and service providers in production</li> </ul>
Lessons learned in up- scaling if any	<ul style="list-style-type: none"> <li>• Working with partners with comparative advantage will ensures success of the project</li> <li>• Availing farmers with adaptable and market preferred varieties enhances technology uptake</li> <li>• Linking entrepreneurs to credit and market enhances adoption of technology</li> <li>• Availability of gross margin information enhances adoption of technology</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Onion is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place</li> <li>• Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased up take.</li> <li>• Existence of suitable bio-physical environments in target counties.</li> <li>• Availability of domestic and regional markets for the commodity.</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000
Estimated returns	KES 1,150,000
Gender issues and concerns in development and, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for onion cultivation than men.</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as quality seeds than men.</li> <li>• Women perform most of the transplanting and weeding activities. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted.</li> <li>• Women may not have time and mobility to attend trainings and other extension activities far from home or held at times when they are performing other domestic roles.</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Introduction of labor intensive tools such as the weeder will reduce women's work burden.</li> <li>• Employment opportunities exist for youth males and men in operating the weeder, spraying and transportation of onions from the farm to the market.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for onion cultivation than men.</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as quality seeds and equipment than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>• Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> <li>• Introduction of labor intensive tools such as the weeder will reduce the labour burden of VMGs such as the elderly and those abled differently.</li> <li>• Employment opportunities exist for youth males in operating the weeder and spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
F: Status of TIMP Readiness (1. Ready for	Ready for upscaling

up scaling; 2. Requires validation; 3. Requires further research)	
Application guidelines for users	Field technical guide 2015
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● KALRO</li> <li>● M. Waiganjo, V. Ochieng, F. Wayua, R.Faraay, J. Mbaka, L. Wasilwa and W.Owino</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> </ul>

## 2.2 Onion Seed Systems

<b>2.2.1 TIMP Name</b>	<b>Onion seed production</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to limited availability and access to quality onion seed
What is it? (TIMP description)	This is the production of open pollinated onion seeds from planted improved varieties.
Justification	Availability of quality seed is mandatory for the farmer to get the potential yields and for the crop to tolerate abiotic and biotic environmental stresses. However, the only source of onion seed in the country are the seed companies. Production of own or community produced seed will help bridge the gap towards access to improved seed varieties.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Onion farmers</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>● Demonstrations</li> <li>● Exhibitions</li> <li>● Media</li> <li>● Shows and Workshops</li> </ul>

	<ul style="list-style-type: none"> <li>● AIPs</li> <li>● Digital platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Resilient seed systems</li> <li>● Affordability of certified seed</li> <li>● Good extension support</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● KALRO-Validation of seed performance</li> <li>● KALRO Seed Unit-distribution of seedlings</li> <li>● Seed companies- importation or manufacture of seeds</li> <li>● NGOs-Evaluation of seeds</li> <li>● Extension- linkage with farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>● Machakos, Kajiado, Bungoma, Nyeri, Isiolo, West pokot, Taita Taveta, Narok, Baringo</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>● Baringo, Busia, Kericho, Kisumu, Laikipia, Wajir, Homabay, Migori, Siaya, Makeni, Kitui, Machakos, Tharaka-Nithi, Embu, Meru.</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Low awareness of the various seed sources</li> <li>● Ignorance of the importance of quality seed</li> <li>● Low financial ability to regularly produce early generation seed leading to low quality of certified seed</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Information dissemination on the seed and seed sources</li> <li>● Scaling up information on sources and cost of seed</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Partnership with stakeholders in solving a challenge quickly yield results</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Awareness of benefits of quality seed to the growing community</li> <li>● Create an enabling environment for seed access to farmers</li> <li>● Formulation of policy for seed production</li> <li>● Establishment of seed marketing systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>● 250/- per kg of seed</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>● High when use of appropriate variety is applied</li> </ul>
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth have less access to credit to purchase the required inputs such as quality onion seeds.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and men in operating in owning and operating agro-chemical business enterprises</li> </ul>

	<ul style="list-style-type: none"> <li>● Affirmative action opportunities such as the women enterprise fund and youth funds exist for women and youths to access the required finances.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as quality seeds.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and extension services than men.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for funds provision from the government through affirmative action exist for VMGs e.g. the youths' funds and the women enterprise fund.</li> <li>● Increased production will lead to increased consumption and utilization of nutritious onions and hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<b>Reference</b>
<b>F: Status of TIMP readiness</b> (1-ready for up scaling;, 2- requires validation; 3-requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	(KALRO Rebecca N. Faaray, Fatuma Omar
Partner organizations	Kenya Seed Company, dry land seed company, Seedco company

### 2.3 Good Agricultural Practices (GAPS) & Food Safety Management Systems in Onion

<b>2.3.1. TIMP Name</b>	<b>Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Onion Value Chain in Kenya</b>
Category (i.e. technology,	Management Practice

innovation or management practice)	
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<p>Presence of chemical, biological and physical hazards in the Onion value chain in Kenya have a direct effect on consumers' health thereby constantly increasing demand for high quality of the produce and its by-products from consumers and public health departments in counties.</p> <p>These hazards have direct economic consequences affecting families, communities and industries subsisting on the Onion value chain in Kenya.. The biological contaminations previously reported on this value chain include presence of <i>Escherichia coli</i> (E. coli), <i>Salmonella</i> spp., <i>Aspergillus flavus</i> and <i>Aspergillus parasiticus</i>. The chemical hazards due to heavy metal accumulations like lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards cause neurological disorders, cancer and birth defects to the consumers in the value chain.</p>
What is it? (TIMP description)	<p>Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Onion value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the Onion supply from biological, chemical and physical hazards into the hands of food management systems.</p>
Justification	<p>The only important tool kit to assure food safety through monitoring in the Onion 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 Onion value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the Onion value chain will easily be identified through critical control points. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range required.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<p>Onion value chain actors from farmers, traders, food vendors and consumers.</p>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>● Evaluation of the entire value chain by determining contamination hazards in primary production systems and available control methods for: <ul style="list-style-type: none"> <li>● Chemical, physical and biological contaminants</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>● Establishment of verification procedures</li> <li>● Involvement of stakeholders in addressing the hazard problems</li> <li>● National and County level, common interest groups discussions</li> </ul>

	<ul style="list-style-type: none"> <li>● Field days, exhibitions</li> <li>● Radio, TV and social media (Whats App, Facebook, Twitter).</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Composition of an expert team of HACCP specialist, food scientist, microbiologist, representative of the onion growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards</li> <li>● Distribution of the printed HACCP plan to Onion value chain actors for implementation in order to reduce hazards.</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>● Institutions responsible for legislating in food safety, regulations and sale of pesticides</li> <li>● Institutions with the required analytical testing</li> <li>● Producers and exporters associations.</li> <li>● County extension staff</li> <li>● Universities (Public and Private)</li> <li>● NGOs</li> <li>● Private sector</li> <li>● Processors and local traders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted. if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> <li>● All counties growing and consuming Onion in Kenya.</li> </ul>
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Inadequate funds to reach value chain actors</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Funding of dissemination platforms</li> </ul>
Lessons learned in up scaling, if any	The value chain of onion 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"> <li>● The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in onion value chain.</li> <li>● market will absorb the cost of implementing the GAPs</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women have less access to agricultural information, technology and knowledge on HACCP than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Proper application of HACCP will lead to improved health of the various gender categories due to consumption of clean healthy onions that are free from hazards.</li> </ul>

<p>VMG issues and concerns in development, dissemination, adoption and scaling up</p>	<ul style="list-style-type: none"> <li>● Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled.</li> <li>● VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>● High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.</li> </ul>
<p>VMG related opportunities</p>	<ul style="list-style-type: none"> <li>● Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean healthy onions that are free from hazards.</li> </ul>
<p><b>E: Case studies/profiles of success stories</b></p>	
<p>Success stories</p>	<p>N/A</p>
<p>Application guidelines for users</p>	<ul style="list-style-type: none"> <li>● Anthony Nyagah, John N. Ndung’u, James Ndambuki, Harun Odhiambo, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Food Safety Culture</b>,</li> <li>● John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Mycotoxins</b></li> <li>● John N. Ndung’u, Anthony Nyagah, James Ndambuki, Harun Odhiambo, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Physical Hazards in Food.</b></li> <li>● John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Biological Hazards</b></li> <li>● John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Chemical Hazards</b></li> <li>● John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Hazard Analysis Critical Control Point (HACCP)</b></li> </ul>
<p><b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)</p>	<p>Ready for up scaling;</p>
<p><b>G: Contacts</b></p>	
<p>Contacts</p>	<p>Centre Director, Food Crops Research Centre, Njoro.</p>

	CD.NJORO@kalro.org
Lead organization and scientists	KALRO John Ndung'u, Antony Nyaga, Francis Wayua, Lusike Wasilwa, Violet Kirigua and Beatrice Wanjiku 1. 2. ,
Partner organizations	<ul style="list-style-type: none"> <li>MoA, AFA, FPEAK, NGO's and Universities, PCPB, AAK, KEPHIS, County governments,</li> </ul>

<b>2.3.1. TIMP Name</b>	<b>Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Onion Value Chain in Kenya</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Presence of chemical, biological and physical hazards in the Onion value chain in Kenya have a direct effect on consumers' health thereby constantly increasing demand for high quality of the produce and its by-products from consumers and public health departments in counties. These hazards have direct economic consequences affecting families, communities and industries subsisting on the Onion value chain in Kenya.. The biological contaminations previously reported on this value chain include presence of <i>Escherichia coli</i> (E. coli), <i>Salmonella</i> spp., <i>Aspergillus flavus</i> and <i>Aspergillus parasiticus</i> . The chemical hazards due to heavy metal accumulations like lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards cause neurological disorders, cancer and birth defects to the consumers in the value chain.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Onion value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the Onion supply from biological, chemical and physical hazards into the hands of food management systems.
Justification	The only important tool kit to assure food safety through monitoring in the Onion 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 Onion value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the Onion value chain will easily be

	identified through critical control points. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range required.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion value chain actors from farmers, traders, food vendors and consumers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Evaluation of the entire value chain by determining contamination hazards in primary production systems and available control methods for:</li> <li>● Chemical, physical and biological contaminants</li> </ul>
	<ul style="list-style-type: none"> <li>● Establishment of verification procedures</li> <li>● Involvement of stakeholders in addressing the hazard problems</li> <li>● National and County level, common interest groups discussions</li> <li>● Field days, exhibitions</li> <li>● Radio, TV and social media (Whats App, Facebook, Twitter).</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Composition of an expert team of HACCP specialist, food scientist, microbiologist, representative of the onion growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards</li> <li>● Distribution of the printed HACCP plan to Onion value chain actors for implementation in order to reduce hazards.</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>● Institutions responsible for legislating in food safety, regulations and sale of pesticides</li> <li>● Institutions with the required analytical testing</li> <li>● Producers and exporters associations.</li> <li>● County extension staff</li> <li>● Universities (Public and Private)</li> <li>● NGOs</li> <li>● Private sector</li> <li>● Processors and local traders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted. if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> <li>● All counties growing and consuming Onion in Kenya.</li> </ul>
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Inadequate funds to reach value chain actors</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Funding of dissemination platforms</li> </ul>
Lessons learned in up scaling, if any	The value chain of onion 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"> <li>• The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in onion value chain.</li> <li>• market will absorb the cost of implementing the GAPs</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Women have less access to agricultural information, technology and knowledge on HACCP than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Proper application of HACCP will lead to improved health of the various gender categories due to consumption of clean healthy onions that are free from hazards.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean healthy onions that are free from hazards.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	N/A
Application guidelines for users	<ul style="list-style-type: none"> <li>• Anthony Nyagah, John N. Ndung’u, James Ndambuki, Harun Odhiambo, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Food Safety Culture</b>,</li> <li>• John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Mycotoxins</b></li> <li>• John N. Ndung’u, Anthony Nyagah, James Ndambuki, Harun Odhiambo, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Physical Hazards in Food</b>.</li> <li>• John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Biological Hazards</b></li> </ul>

	<ul style="list-style-type: none"> <li>John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Chemical Hazards</b></li> <li>John N. Ndung’u, Anthony Nyagah, Harun Odhiambo, James Ndambuki, Violet Kirigua, Lusike Wasilwa and Godwin Macharia. (August, 2021), <b>Hazard Analysis Critical Control Point (HACCP)</b></li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling;
<b>G: Contacts</b>	
Contacts	Centre Director, Food Crops Research Centre, Njoro. CD.NJORO@kalro.org
Lead organization scientists and	KALRO John Ndung’u, Antony Nyaga, Francis Wayua, Lusike Wasilwa, Violet Kirigua and Beatrice Wanjiku
Partner organizations	<ul style="list-style-type: none"> <li>MoA, AFA, FPEAK, NGO’s and Universities, PCPB, AAK, KEPHIS, County governments</li> </ul>

<b>2.3.2. TIMPs name</b>	<b>Good Agricultural Practices (GAP) for Onion</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>Declining food safety due to inadequate good agricultural practices</li> </ul>
What is it? (TIMP description)	GAP is a systematic process of implementing a standardized production system globally designed to reassure consumers on the food production process on the farm, pre-farm gate or on-farm standards. It is not about a specific crop production but the process through which production takes.

Justification	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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• All Onion value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Farmer Field Business Schools (FFBS)</li> <li>• On-farm experimentation and dissemination</li> <li>• Field days, shows, farmer to farmer communication,</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Policy support from government</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Producer organizations, NGO's, MoA, Private extension providers, CoG and other value chain players</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>• All counties in Kenya where Onion is produced and consumed</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack/inadequate knowledge on the benefits of GAPs</li> <li>• Lack of legislative mechanisms to support the GAP, in particular the domestic scope</li> <li>• The perception that GAP is oppressive rather than supportive</li> </ul>
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>• The low number of stakeholders aware of GAP</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Supportive policy of national and county governments to promote adoption of GAP's.</li> <li>• Market will absorb cost of instituting GAPs</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• To be determined</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• To be determined</li> </ul>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women have less access to agricultural information, technology and knowledge on GAP than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• Proper application of HACCP will lead to improved health of the various gender categories due to consumption of clean healthy onions that are free from hazards.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Proper application of GAP will lead to improved health of the various gender categories due to consumption of clean health onions that are free from hazards.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• None</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Options for certification exist depending on whether it is a single holder certification or group compliance.</li> <li>• Compliance is a process and hence takes time and involves a process of continuous improvement.</li> <li>• No need for farm sophistication to adopt.</li> <li>• There is provision for taking corrective action for all noncompliance at time of assessment.</li> <li>• Requires continuous training and exposure to better systems.</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	
Lead organization and scientists	<ul style="list-style-type: none"> <li>• KALRO Nyaga A., Ndung'u, J., Wayua, F., Wasilwa, L and Kirigua, V.</li> </ul>
Partner organizations and their roles	<ul style="list-style-type: none"> <li>• MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.</li> </ul>

## 2.4 Onion Agronomy Package

<b>2.4.1. TIMP Name</b>	<b>Use of nursery raised clean seedlings</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to planting of diseased low/vigour seedlings

What is it? (TIMP description)	It is the propagation of onion seedlings from seed from seeds for later transplanting in the field.
Justification	Planting of diseased low/vigour seedling leads to low yields. Nursery raised seedlings are disease free, vigorous and have potential for better establishment, leading to high yields.
Region promoted	<ul style="list-style-type: none"> <li>All onion growing regions</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>Producers (farmers), extension agencies, formal and informal nursery operators</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>Use of service providers,</li> <li>FFBS</li> <li>Demonstrations,</li> <li>Farmers' tours</li> <li>AIPs</li> <li>Digital platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Availability of certified seeds</li> <li>Sensitisation of farmers</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>NGOs, extension, private service providers, nursery operators, seed Companies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	<ul style="list-style-type: none"> <li>Kiambu, Nyeri, Kajiado, Keiyo Marakwet, Machakos,</li> </ul>
Counties where TIMPs can be up-scaled	<ul style="list-style-type: none"> <li>All Counties undertaking onion production</li> </ul>
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>Low farmer capacity</li> <li>Lack of credit facilities for establishing nurseries</li> <li>Inadequate water sources</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>Build the capacity of farmers</li> <li>Provision of credit for raising nurseries</li> <li>Provision of supplementary irrigation</li> </ul>


Lessons learned in up scaling	<ul style="list-style-type: none"> <li>Youth can be engaged in transportation of onion seedlings to the market hence creation of employment</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>Enabling policy environment for operation of nurseries</li> <li>Market will be able to absorb the extra produce at reasonable prices</li> </ul>
<b>Basic costs</b>	<ul style="list-style-type: none"> <li>Nursery construction, materials and management is both cost and labour intensive</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>Returns are high when the right crop species and demand led production is undertaken</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Women and youth have limited access to land for onion cultivation than men</li> <li>Women and youth may also have limited access to finances to buy the required inputs such as seeds than men.</li> <li>Women and youth may have limited access to farm inputs than men</li> <li>Women and youth may have less access to credit than men</li> <li>Women and youth may have less access to labour than men</li> <li>Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Employment opportunities for youth males and men exist in the raised nursery preparation.</li> <li>Opportunities exist for women to access the required credit through the women enterprise funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have limited access to land for onion cultivation than men.</li> <li>VMGs may also have limited access to finances to buy the required inputs such as seeds and equipment than men.</li> <li>VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>Increased production will lead to increased consumption and utilization of onions and hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories	<ul style="list-style-type: none"> <li>• None</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Onion Production Manual</li> <li>• Onion growing brochure</li> </ul>
F. Status of TIMP readiness: 1. Ready for upscaling; 2. Require validation; and 3. Require further research	<ul style="list-style-type: none"> <li>• Ready for up-scaling</li> </ul>
<b>G: Contacts</b>	
Contacts	The Institute Director, Horticulture Research Institute P.O. Box 220-0100, Thika Director.Fcric@kalro.org
Lead organization and scientists	KALRO Rebecca N. Faraay, Fatuma Omar
Partner organizations	AVDRC, UoN, Egerton University, JKUAT

### Research GAPS

1. Validation of nurseries for different crops and environments

## 2.5. Soil Fertility Management

2.5.1 TIMP name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to land degradation (declining soil fertility, increased soil moisture stress, increased soil erosion and poor soil health.
What is it? (TIMP description)	<p>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>  <p><b>Manure Pile</b></p>

Justification	Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the nutrients (macro and micro) in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential of providing the limiting nutrients and improving the soil health.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Onion farmers, extension service providers and trainers of trainers.</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Open days and field days</li> <li>● Exchange visits</li> <li>● On farm demonstrations</li> <li>● Publications</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Farmers sensitized on feeding, management and use of manure</li> <li>● Existing model demonstration plots using onion crops</li> </ul>
Partners/stakeholders for scaling up and their roles	County Governments, Provide extension services, farmer mobilization and policy formulation ILRI, technical backstopping NGOs – micro financing services
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	-None
Counties where TIMP will be promoted	<ul style="list-style-type: none"> <li>● All counties with suitable agro-ecological conditions for Onion production.</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>● National and County Governments Ministry of Agriculture, Livestock and Fisheries</li> <li>● Provide extension services-</li> <li>● farmer mobilization and policy formulation</li> <li>● ILRI, technical -backstopping NGOs – micro financing services</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establishment of many demonstration plots by County Governments</li> <li>● Capacity building of communities on manure management and its benefit</li> <li>● Continuous capacity building of farmers and extension service providers</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>● Proper use of manures improves soil fertility</li> <li>● Use of manure enhances crop productivity</li> <li>● There is need for building capacity in skills in manure preparation, storage and application</li> </ul>
Social, environmental, policy and market conditions necessary	<p>The target communities will be willing and able to accept and adopt the practice</p> <p>Manure will be available and affordable</p> <p>There will be an enabling policy environment for the use and management of manures</p> <p>Market will be able to absorb the extra produce and cost of manure application</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women and youth may also have limited access to inputs such as manures than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for women earn more income from the resulting increased production.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs may also have limited access to finances to buy the required inputs such as manures than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>● Increased production due to use of manure will lead to increased consumption and utilization of onions in the home stead and hence improved health of VMGs.</li> </ul>

<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers who adopt manure management practice have reported improved soil health, increased crop yield, and sustainable source of income
Application guidelines for users	The guideline focuses on the following areas: <ul style="list-style-type: none"> <li>● Animal feeds</li> <li>● Livestock housing and manure collection</li> <li>● Manure storage to preserve nutrient and avoid losses</li> <li>● Manure treatment for ease of transport and application in the field</li> <li>● Timing of application for maximum utilization by the crop</li> <li>● Anaerobic digestion for biogas production</li> <li>● Regular analysis of manure to ascertain the quality</li> <li>● Manure/Composts take a long time to cure, hence need good planning prior to use</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO Secretariat Box <b>Post Office:</b> P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email :</b> info@kalro.org,
Lead organization and scientists	KALRO S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba, H. Odhiambo, Wandera. F.M
Partner organizations	County government, Private Public Partnerships

#### Research GAPS

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

<b>2.5.2. TIMP name</b>	<b>Integrated Soil Fertility Management (ISFM)</b>
Category (i.e. technology, innovation or management practice)	Management Practice

<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to declining soil fertility, low organic matter, poor soil structure and insufficient soil moisture
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	Declining soil fertility and soil degradation is a major impediment to current and future agricultural productivity in Kenya, particularly in areas that are under continuous cropping. The sustainability of these soils and environments depends on the management and treatment of the soils. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers, researchers, extension service providers</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Training in workshops</li> <li>● On-farm visits</li> <li>● Farmer field schools (FFS)</li> <li>● On-farm demonstrations (during FFS)</li> <li>● Open days, field days</li> <li>● Publications</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of affordable and quality manure, fertilizers and clean planting materials</li> <li>● Ability of farmers to afford the inputs required</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County Government extension services to provide link with farmers and mobilize their participation</li> <li>● Community farmer groups; play coordination role for ease in problem identification and dissemination.</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	None
Counties where TIMP will be promoted	<ul style="list-style-type: none"> <li>● All counties with suitable agro-ecological settings for onion production.</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Change of mindset in some regions/cultures that organic manures cannot be applied on crops</li> <li>● Misconceptions that chemical fertilizers damage the soils</li> <li>● Limited availability of manure for farmers who do not keep livestock</li> <li>● High cost of transporting manure from areas that have</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Awareness trainings on role of organic manures in crop cultivation</li> <li>● Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers</li> </ul>
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, is required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>● Practice is socially acceptable</li> <li>● The practice is Environmentally friendly</li> <li>● Increased productivity will be absorbed by the markets</li> <li>● Supporting frameworks/policies are available</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
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"> <li>● It is labour intensive hence may not be adopted by women who are already overburdened</li> <li>● Women and youth have limited access to credit to purchase the required inputs such as such as fertilizers than men</li> <li>● Women and youth have limited access to land for onion cultivation than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for women earn more income from the resulting increased production.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>● It is labour intensive hence may not be adopted by some VMGs who are elderly.</li> <li>● Women and youth have limited access to to credit to purchase the required inputs such as such as fertilizers than men.</li> </ul>
VMG related	<ul style="list-style-type: none"> <li>● Affirmative action in various areas as for instance in the provision of finances to VMGs</li> </ul>

opportunities	<ul style="list-style-type: none"> <li>Increased production due to use of the TIMP will lead to increased consumption and utilization of onions and hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	ISFM successes have been reported in sorghum and millet value chains in Machakos where productivity has been improved
Application guidelines for users	<ul style="list-style-type: none"> <li>Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients.</li> <li>Ensure that good agronomic practices are upheld</li> <li>For sustainability, lone use of inorganic or organic materials should be avoided.</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kabete Email: CD.NARL@kalro.org
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa, F.M. Wandera
Partner organizations	County governments KEFRI

### Research GAPS

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

<b>2.5.3. TIMP name</b>	<b>Rapid soil testing services</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields and increased cost of production due to inappropriate use of soil fertility management practices (fertilizer and manure).
What is it? (TIMP description)	The simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue is used to give results instantly. Farmers need to know the condition of their soil to be able to make informed decisions on soil fertility management options. There is need for reliable, reproducible and rapid soil testing services accessible to farmers.

Justification	Farmers need to know the condition of their soil to be able to make informed decisions on soil fertility management options. There is need for reliable, reproducible and rapid soil testing services accessible to farmers
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers, Extension officers</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer visits</li> <li>● Training in workshops</li> <li>● Publicity campaigns done at County levels.</li> <li>● Publications</li> <li>● Field days</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion.	<ul style="list-style-type: none"> <li>● Availability of the necessary equipment for rapid on the spot soil testing.</li> <li>● Established rapport between farmers and the technical personnel involved in soil testing.</li> <li>● Adequate qualified staff to cover the large number of samples from the 24 counties before the planting season begins.</li> <li>● A well-designed storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw scanned data, and fertilizer recommendation according to crop type suitability).</li> <li>● Availability a van to mount the equipment.</li> <li>● Farmers must understand, trust, and be willing to act upon the information provided</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension services; providing the link to farmers given that agriculture is devolved.</li> <li>● Soil Cares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF,</li> <li>● ICRAF and iSDA tests and validates the recommendation obtained in collaboration with Soil Cares and KALRO.</li> <li>● Fertilizer companies; To provide fertilizer blends according to soil health status</li> <li>● Agro dealers to stock required fertilizers that are readily available to farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	None
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>● All Counties with suitable agro-ecological settings for Onion production.</li> </ul>


Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of awareness on the importance of regular testing of soil quality</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Awareness creation, intensive farmer field training (capacity building)</li> <li>● Make the whole process cost efficient.</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Timely affordable soil information will guide on fertilizer use.</li> <li>● Application of fertilizers in the absence of knowledge for the soil demand in terms of macro and micro elements may give no results</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Socially acceptable-brings income, increases food production, nutrition security and family cohesion.</li> <li>● Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water.</li> <li>● Increased productivity will provide supply to the markets Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>● Yet to be determined</li> </ul>
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● May offer employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Has been tested and used successfully by other organizations like ICRAF, Soil Cares & KESREF.
Application guidelines for users	<ul style="list-style-type: none"> <li>● A handheld scanner for testing soils and crops in the field</li> <li>● Community soil sampling champions are identified and trained on good soil sampling procedures.</li> <li>● Soil and crop is analyzed and the results including fertilizer recommendation generated on site.</li> </ul>

<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO Secretariat Box <b>Post Office:</b> P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email :</b> info@kalro.org,
Lead organization and scientists	KALRO; F.M Wandera, A. Sila, D. Kamau, A.O. Esilaba
Partner organizations	County governments in the 24 counties, Soil Cares, ICRAF and SIDA

### Research GAPS

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

<b>2.5.4 TIMP Name</b>	<b>Low-Cost Composting</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to soil degradation (declining fertility, increased moisture stress, poor soil structure).

<p>What is it? (TIMP description)</p>  <p>Composting using plant residues</p>	<p>The practice of recycling organic wastes intended for use in agriculture by allowing the biological decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms under controlled aerobic conditions resulting in an accumulation of partially decayed organic matter called humus.</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 being depleted at annual rate of 22kg/ha for nitrogen, 2.5kg/ha for phosphorus, and 15kg/ha for potassium.</p> <p>Compost contains the nutrients nitrogen, phosphorus and potassium that are found in most chemical fertilizer and even secondary and trace elements (such as zinc, iron and magnesium) that are not, and which are useful to the roots of growing plants. The compost also adds balanced nutrients to soil in an easily assimilated form, and helps improving soil structure by lightening heavy clays and improving water retention properties in porous sands</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<ul style="list-style-type: none"> <li>● Farmers</li> </ul>
<p>Approaches to be used in dissemination</p>	<ul style="list-style-type: none"> <li>● Open days and field days Exchange visits</li> <li>● On farm demonstrations</li> <li>● Mass and social media</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>● Training on different composting techniques and use</li> <li>● Dissemination approach used to reach target farmers</li> <li>● Model demonstration plots</li> </ul>
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> <li>● County government extension services - Provide link with farmers.</li> <li>● Community farmer groups - play coordination role for ease in problem identification and dissemination</li> <li>● ILRI - technical backstopping</li> <li>● NGOs – micro financing services</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted if any</p>	<ul style="list-style-type: none"> <li>● Tharaka Nithi, Kajiado, Nyeri, Bomet, Uasin Gishu, Kakamega, Busia, Machakos</li> </ul>
<p>Counties where TIMP will be promoted</p>	<p>All 24 KSAP counties</p>


Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of model demonstration farms</li> <li>● Lack of continuity in training of extension staff and farmers in composting skills</li> <li>● Lack of proper mobilization mechanism for reaching many farmers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establishment of many demonstration plots by counties</li> <li>● Capacity building of smallholder farmers on composting management and its benefit</li> <li>● Continuous capacity building of farmers and extension workers</li> <li>● Use of approaches to mobilize farmer to attend demonstration forums</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>● Proper use of composts to improve soil fertility</li> <li>● Use of composts to enhance crop productivity</li> <li>● Skills in composting methodologies and minimizing health risks associated with compost making</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● The waste may contain heavy load of pathogens</li> <li>● Also compost pits if not well managed can be a source of contamination by leaching of nutrients.</li> <li>● Generally, applying composts to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Preparation of composts require labour for building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time Using locally available composts saves on purchase of inorganic fertilizer.
Estimated returns	
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to land for onion cultivation than men. <ul style="list-style-type: none"> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul> </li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men.</li> </ul>

	<ul style="list-style-type: none"> <li>Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in soil sampling.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers who use composts in quickly maturing crops have reported 3 to 5 times increased production due to improved soil health and better income
Application guidelines for users	<p>The guidelines for users focus on the following areas:-</p> <ul style="list-style-type: none"> <li>Need to mix the compost with the soil to ensure adequate nutrition in the rooting zone.</li> <li>Compost storage to preserve nutrient and avoid losses.</li> <li>Timing of application for maximum utilization by the crop.</li> </ul>
	<ul style="list-style-type: none"> <li>Regular analysis of compost to ascertain the quality including contaminants like heavy metals and pathogens.</li> <li>Type of composts and quality that will determine the application rates.</li> <li>Materials that cannot be used for composts include, charcoal ashes, dog/cat manure, meat/animal fat, leaves or biomass from certain tree species that have toxic levels for microbes, e.g. eucalypts and cassia spp.</li> </ul> <p><u>Reference</u> Karanja NK, Kwach HO, Njenga M (2005). Low cost composting training manual. Techniques based on the UN Habitat urban harvest CIP community based waste management initiative.</p>
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	2- Requires validation
<b>G: Contacts</b>	
Contacts	<p>Director, Environment &amp; Natural Resources KALRO HQ P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email</b> : info@kalro.org</p>
Lead organization and scientists	KALRO, B. Mugo, D. Kamau, E. Mutuma, M. Okoti
Partner organizations	County government, NGO's

#### Research GAPS

- Promote composting technology in counties that have not practiced it.
- Conduct nutrient budget study on selected farms using composts in the 24 Counties.

## 2.6 Soil and Water Management


2.6.1 TIMP name	Contour bunds
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to soil degradation (soil erosion increased run off, low soil water retention)
What is it? (TIMP description) Contour bands	<p>Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus, contour bunds resemble narrow channel terraces commonly referred to as “<i>Fanya chini</i>” terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).</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. Contour bunds resemble narrow channel terraces commonly referred to as “<i>Fanya chini</i>” terraces. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. This also decreases the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas crops requiring less water, such as onion, can be planted on the ridges.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension information materials distributed to farmers through farmer groups and the County extension service providers.</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Farmers and extension service with skills to design and construct contour bunds.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>● Community farmer groups – establishment on-farm demonstration plots to hold farmer field schools.</li> <li>● External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	-
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for onion production.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>● Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds are reluctant to invest in the Practice</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate equipment for preparation of contours for efficiency and increased output per man hour.</li> <li>● Training youthful farmers to be champions of contour bunds construction at the ward level/village level.</li> <li>● Training on site specific designs and construction of contour bunds</li> <li>● Fast-track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>● Contour bunds are popular largely due to the rapid benefits it gives in terms of improved crop performance.</li> <li>● Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>● Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>● Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Create awareness on the importance of soil and water conservation</li> <li>● Enabling policies on soil and water conservation at the county level</li> <li>● Avail low-cost technologies for soil and water conservation</li> <li>● Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for male youth for employment exist in the task of construction of contour bunds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited rights to land for onion cultivation than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for youth males employment exist in the task of constructing contour bunds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	None
Application guidelines for users	Soil and water Management Manual Fact sheets
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director KALRO</b> Kabete, off Waiyaki way P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Government's extension offices.

### Research GAPS for further research

1. Develop site specific designs for construction – validation in other regions
2. Conduct trade off analysis (economic analysis) of contour bunds as a soil and water management technology in the various AEZs and along specific value chains
3. Develop low-cost mechanized tools to ease labor demands in contour construction and maintenance


<b>2.6.2. TIMP name</b>	<b>Zai Pits</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to unreliable water to sustain a crop as a result of high seasonal rainfall variability leading to total crop failures.
What is it? (TIMP description)	<p><i>Zai Pits</i> are small planting pits typically measuring 15-30 cm in width, 10-20 cm deep and spaced 60-80 cm. <i>Zai Pits</i> harvests and stores water for prolonged crop use. Farmers plant seeds into the pits after filling one to three handfuls of organic material such as manure, compost, or dry plant biomass. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).</p>  <p>Zai pits</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. <i>Zai Pits</i> have the potential to harvest and store rain water for prolonged crop use. This technology also contributes to improving the management of degraded lands, reducing soil erosion, vegetation loss and biodiversity as well as crop yield.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
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"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training in workshops.</li> <li>● Publications</li> <li>● Digital platforms.</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Farmers and extension service with skills to design and construct <i>Zai</i> pits.</li> <li>● Availability of affordable organic matter i.e. manure, compost.</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension services –delivery of information inputs to farmers.</li> <li>● Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools</li> <li>● NGOs – capacity building, policy support in soil and water conservation issues</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Onion production.
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement on large scale.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate equipment for efficient preparation of <i>Zai</i> pits.</li> <li>● Training youthful farmers to be champions of <i>Zai</i> pits construction at the Ward level/village level.</li> </ul>
Lessons learned, if any	The technology has huge potential to increase farmers’ resilience especially in ASALs. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it to maximize yields.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Creation of awareness on the importance of soil and water conservation</li> <li>● Provision of low-cost technologies for soil and water conservation</li> <li>● Friendly policy environment on soil and water conservation at the County level</li> <li>● Policies that support individual land tenure systems</li> <li>● Provision of support in the establishment of the <i>Zai</i> pits</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for <i>Zai pit</i> preparation. It is estimated at KES 40 to 100 per <i>Zai Pit</i>
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for employment for male youth exist in the construction of <i>zai</i> pits.</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited rights to land for implementation of the practice cultivation than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>● Opportunities for employment for male youth exist in the construction of zai pits.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited rights to land for implementing the practice.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	<p>Two women groups in Kiliki, Matungulu sub-County of Machakos County through a representative Janet Ndunge reported having started using the <i>Zai pit</i> farming technology in 2013 after attending a farming workshop by the Institute for Culture and Ecology (ICE). “Ever since we started using <i>Zai pits</i>, we have seen an increase in our harvests as compared to the conventional methods of farming,” she said.</p> <p>Farmers in Kathonzweni, Makueni County increased dug pits from 170 to 500 pits for crop production due to initially observed benefits. Communities in ASALs have also rehabilitated degraded lands and increased production significantly.</p>
Application guidelines for users	Soil and Water management Manual Soil and water management brochure
<b>F: Status of TIMP readiness</b> (Ready for up scaling, Requires validation; Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks 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. Ketiem, J. Mwaura; D. Kamau and A.O. Esilaba., F.M Wandera
Partner organizations	County Government’s extension offices.

## Research GAPS


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

<b>2.6.3. TIMP name</b>	<b>Bench terraces</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
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>Bench terraces are constructions of a series of level or close to level beds running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.</p>  <p>Bench terraces</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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension providers
Approaches to be used in dissemination	<p>Approaches to be used in the dissemination include:</p> <ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension publications.</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Skills among Farmers and extension service to design and construct contour bunds.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>● Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools.</li> <li>● External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Onion production.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale</li> <li>● Land tenure systems – reluctance to invest in the TIMP under communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour.</li> <li>● Training youthful farmers to be champions of construction of bench terraces at the ward level/village level.</li> <li>● Training on site specific designs and construction of bench terraces</li> <li>● Fast track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>● Terracing is popular largely due to the rapid benefits it gives in terms of improved crop performance.</li> <li>● Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>● Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>● Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary for promotion	<ul style="list-style-type: none"> <li>● Awareness and acceptability of the importance of soil and water conservation</li> <li>● Avail low-cost technologies for soil and water conservation</li> <li>● Friendly policies environment on soil and water conservation at the county level</li> <li>● Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited rights to land for implementation of the TIMP than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for males youth exist in performing the task of bench terraces.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● VMGs have limited rights to land for implementing the TIMP than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for male youth exist in construction of bench terraces.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	<p>Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed it away. But after we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new technology for their crops"</p>
Application guidelines for users	<p>Terraces draining in one direction should be at least 100m or more. The length can be slightly increased in arid and semi-arid regions. The width of the bench (flat part) is determined by soil depth, crop requirements, and tools to be used for cultivation. Optimum width of terrace benches ranges from 2.5 to 5 m for manually constructed ones and from 3.5 to 8 m for machine built and tractor-cultivated ones.</p> <p>Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 0.5% in arid or semi-arid regions to 3% in humid regions with clay soils. Maximum gradients can be 5% for reverse terraces. In high rainfall areas (more than 1000 mm annually), it is necessary to make additional drainage provisions off the terraces – although this has a risk of causing erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.</p>

<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling.
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Government's extension offices.

<b>2.6.4 TIMP name</b>	<b>Fanya Juu Terraces</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
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 embankments made by excavating soil and throwing it up-slope to stop the flow of water. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as Onions may then be grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off.</p>  <p>Fanya Juu Terraces</p> <p>The technology is highly suitable for 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>

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 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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension publications.</li> <li>● Digital Platforms</li> <li>●</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Skills among the farmers and extension workers to design and construct contour bunds.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access and capacity building</li> <li>● Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools.</li> <li>● External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for Onion production.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>● Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds there is no incentive to invest in the TIMP</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate equipment for preparation of terraces for efficiency and increased output per man hour.</li> <li>● Training youthful farmers to be champions of 'Fanya juu' terraces construction at the ward level/village level.</li> <li>● Training on site specific designs and construction of 'Fanya juu' terraces</li> <li>● Fast-track land registration.</li> </ul>

Lessons learned, if any	<ul style="list-style-type: none"> <li>● ‘Fanya juu’ terracing is largely popular due to the rapid benefits it gives in terms of soil and water conservation.</li> <li>● Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>● Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>● When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Availability of low-cost technologies for soil and water conservation</li> <li>● Awareness and acceptability on the importance of soil and water conservation</li> <li>● Friendly policies environment on soil and water conservation at the county level</li> <li>● Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for male youth and men for constructing the terraces.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for male youth and men for constructing the terraces.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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 soil conservation in a scheme that involves digging of trenches in hillside to trap runaway water and soil.
Application guidelines for users	Esilaba, A.O. et al. (2021). KCEP-CRAL Integrated Soil Fertility and Water Management Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya

<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Government's extension service.

<b>2.6.5. TIMP name</b>	<b>Stone lines</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity.
What is it? (TIMP description)	Stone lines are stones placed along contour lines to slow down runoff. With time, the soil builds up on the upslope side of the stone line and a natural terrace is formed. The technology is suitable in gentle to moderate slopes (less than 10%); areas with low annual rainfall areas (200 - 750mm); and stony areas
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Stone lines can help in the conservation of soil and moisture.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension publications.</li> <li>● AIPs</li> <li>● Digital platforms</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Farmers and extension service with skills to design and construct stone lines.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access and capacity building.</li> <li>● Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>● External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for Onion production.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>● Land tenure systems – reluctance to invest in the practice under communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate tools for preparation and laying of stones lines for efficiency and increased output per man hour.</li> <li>● Training youthful farmers to be champions of laying stone lines and maintenance.</li> <li>● Training on site specific designs and laying of stone lines</li> <li>● Fast-track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>● Existence of well-developed self-help groups can lead to successful construction of stone lines.</li> <li>● Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>● When farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Enforce policies on soil and water conservation at the county level</li> <li>● Create awareness on the importance of soil and water conservation</li> <li>● Avail low cost technologies for soil and water conservation</li> <li>● Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	For each hectare, transport and other project costs amount to around KES 25,000.
Estimated returns	Not yet determined

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited rights to land for to implement the stone lines than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for youths exist in constructing the lines.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to land for onion cultivation than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for youths exist in constructing the lines.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	In Burkina Faso farmers have reported doubled cereal production when stone lines are used in combination with greater use of compost as fertilizer. <a href="https://www.rural21.com/fileadmin/migrated/content/uploads/Stone_lines_against_desertification_01.pdf">https://www.rural21.com/fileadmin/migrated/content/uploads/Stone_lines_against_desertification_01.pdf</a>
Application guidelines for users	Stone lines are built along the contours. The lines are between 0.5m and 1.5m high, depending on the gradient of the slope. The distance between stone lines ranges from 25 to 40m. Each hectare needs between 30 and 50 tons of stones, which are built into contour lines about 300m long. The stone lines slow the fast-flowing rainwater, thereby reducing erosion. This allows up to 200 more litres of water to penetrate the soil per square metre. The amount of work involved is considerable: to quarry the stone, load it onto lorries and line it on the fields.
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-Requires validation; 3-Requires further research)	1-Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba and H. Odhiambo
Partner organizations	County Government's extension service.

<b>2.6.6 TIMP name</b>	<b>Retention ditches</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion, increased run off and low productivity
What is it? (TIMP description)	Retention ditches are trenches designed to catch and retain incoming runoff and hold it until it infiltrates into the ground. They can be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The technology is suitable in semi-arid areas; permeable, deep and stable soils; and on flat or gentle sloping land.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of 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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension service providers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension publications.</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour as the technology is labour intensive.</li> <li>● Farmers and extension service with skills to design and construct stone lines.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>● Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>● External service providers – capacity building and access to technology.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for Onion production.

Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Increased risk of soil erosion if retention ditches are improperly laid out</li> <li>● Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>● Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate tools for efficiency in digging out retention ditches.</li> <li>● Training youthful farmers to be champions of digging out retention ditches.</li> <li>● Training on site specific designs and layout of retention ditches</li> <li>● Fast-track land registration</li> </ul>
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many would be willing to take it up.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Awareness and acceptability on the importance of soil and water conservation</li> <li>● Availability of low cost technologies for soil and water conservation</li> <li>● Friendly policy environment on soil and water conservation at the County level</li> <li>● Friendly policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>● Women and youth have limited access to land for onion cultivation than men.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for the various gender categories i.e. youths women and men performing the task.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● VMGs have limited rights to land for implementation of retention ditches than men</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities for youths exist in digging the ditches.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	


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 on hillside to trap runaway water and soil.
Application guidelines for users	The ditches are dug to about 30-60cm depth and 0.5-1m width across the direction of the slope. In very stable soils it is possible to make the sides nearly vertical, but in most cases the top width of the ditch needs to be wider than the bottom width. The soil is thrown to the lower side of the slope to prevent it falling back in and form an embankment. On flat land, ditches are spaced at about 20m and have closed ends so that all rainwater is trapped. On sloping land ditches are spaced at 10 - 15m intervals and may have open ends to discharge excess water.
<b>F: Status of TIMP readiness</b> 1-Ready for upscaling, 2-Requires validation; 3- Requires further research)	1-Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba, F.M. Wandera and H Odhiambo.
Partner organizations	County Government's extension service.

<b>2.6.7 TIMP name</b>	<b>Grass strips</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion, increased run off and low productivity.
What is it? (TIMP description)	Grass strips are dense strips of grass planted up to a meter wide, along a contour to check runoff and soil erosion. 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 for regions with fairly gentle slopes (0 - 6%) and high rainfall.

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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training workshops.</li> <li>● Extension publications</li> <li>● Digital platforms.</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of labour</li> <li>● Availability of land, apart from cropland.</li> <li>● Farmers and extension service with skills to design and construct stone lines.</li> <li>● Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>● Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>● External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for Onion production.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>● Labour intensive for maintaining and controlling grass from becoming a weed</li> <li>● Reduced land area for crop production</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Farmers need to be supported with appropriate tools and suitable grass varieties.</li> <li>● Capacity building on the maintenance of grass strips.</li> <li>● Training on site specific designs and layout</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>● Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year.</li> <li>● Grass strips can be very appropriate for farmers who require fodder for their livestock.</li> <li>● Grasses are also used as mulch for crops by farmers.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Awareness and acceptability of the importance of soil and water conservation</li> <li>● Friendly policy environment for soil and water conservation at the county</li> </ul>

	<p>level</p> <ul style="list-style-type: none"> <li>• Availability of low-cost technologies for soil and water conservation</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited rights to land for implementation of grass strips than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for the various gender categories i.e. youths, women and men performing the task.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have limited rights to land for implementation of grass strips than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youths exist in performing the task.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	-
Application guidelines for users	<p>Spacing between grass strips depends on the slope of the land. It can be 20- 30m on gentle slopes and 10-15m on steep land. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. The grass needs to be trimmed regularly, to prevent shading and spreading to crop areas. Various grass species are used, e.g., Vetiver, Napier, Guinea and Guatemala depending on what is locally available. Vetiver grass is drought resistant and good for reducing erosion.</p>
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-Requires validation; 3- Requires further research)	1-Ready for upscaling
<b>G: Contacts</b>	

Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba., F.M. Wandera and H. Odhiambo.
Partner organizations	County Government's extension service.

<b>2.6.8 TIMP name</b>	<b>Tied ridges /Ridging /Earthling</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Crop water stresses in production; increased water losses in the furrows
What is it? (TIMP description)	<p>Tied ridges are small earthen ridges, 30cm high, with an upslope furrow which accommodates water between the ridges. Its purpose is to trap water within the furrow and allow it to infiltrate into the soil.</p> <p>Technology consist of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones. Water is applied to the top end of each furrow and flows down the crop field under the influence of gravity.</p>  <p>Tied Ridges</p>
Justification	With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges helps conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.
Region promoted	Tana River, Garissa, and West Pokot counties
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Demonstrations Farmer field schools

	Publications Digital platforms AIPs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Proximity to water sources - close to permanent water sources</li> <li>● Suitable topography of area (level land)</li> <li>● Technical capacity for maintenance</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County government – capacity building</li> <li>● Private sector – access to credit, capacity building</li> <li>● NGOs (Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM) – capacity building, credit facilities, facilitate technology access</li> <li>● National Irrigation Board – technology access and capacity building</li> <li>● Water Resources Management Authority – Water resources use management</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other counties with suitable agro-ecological settings for Onion production.
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Can be labour intensive during establishment phase</li> <li>● Land tenure insecurity in some counties limits adoption and investments</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>● Encourage group/community action in establishment</li> <li>● Enhance access to credit</li> <li>● Implement policy on land use and tenure</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>● Use of tied ridges with furrow irrigation significantly increases yields</li> <li>● Poor management and designs may often result in flooding of low areas</li> <li>● Assessment of soil erosion and sediment is key to sustainability</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● The economics of furrow irrigation needs to be well articulated</li> <li>● Enhanced land quality control to mitigate against soil salinity</li> <li>● Adequate policies and guidelines regarding water abstraction from the main water sources to minimize resource conflicts especially along river downstream.</li> <li>● Market for the crops produced under irrigation should be identified early enough to minimize losses and increase profitability from the system</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	

Basic costs	Not known
Estimated returns	Not known
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>Women and youth have limited rights to land for implementation of the practice than men.</li> <li>Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Employment opportunities for the various gender categories i.e. youths, women and men performing the task.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>VMGs have limited limited rights to land for implementation of the practice than men</li> <li>Women have less access to agricultural information, technology and knowledge than men.</li> <li>The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>Employment opportunities for youths exist in performing the task.</li> </ul>
VMG related opportunities	VMGs can make business arising from the increased yields from furrow fields.
<b>E: Case studies/profiles of success stories</b>	
Success stories	There are successful models for such technology i.e. Mwea and Perkerra irrigation schemes where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	<ul style="list-style-type: none"> <li>Sijali I V. Drip irrigation: options for smallholder farmers in Eastern and southern Africa. 2001. RELMA Technical Handbook Series 24. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency, (Sida). 60 p. + x p.; includes bibliography</li> <li>FAO CSA Manual</li> <li>FAO Irrigation Water Management: Irrigation Manual</li> <li>GoK MoALF: Training Manual for Water Users Association and farmers</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires	Ready for upscaling

validation; Requires further research)	
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO HQ P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email :</b> info@kalro.org
Lead organization and scientists	KALRO; J. Mwaura, I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority

### Research GAPS

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

<b>2.6.9 TIMP name</b>	<b>Rain water harvesting systems</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed:	Low yields due to erratic unreliable rainfall
What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. Some methods of rainwater harvesting include rooftop harvesting and harvesting through earth dams.
Justification	Water availability, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage. By collecting, storing and utilizing water for agricultural purposes, farmers are able to prevent surface runoff, soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high-value crops, and extending their growing season through the entire year.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, pastoralists and agro-pastoralist

Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Demonstrations on technology use;</li> <li>● Farmer Field Schools;</li> <li>● Technical training and re-tooling of extension personnel;</li> <li>● Mass media</li> <li>● Digital platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of resources (human, technical and financial) to support acquisition and establishment of water harvesting systems</li> <li>● Friendly Policies to support use of communal land to establish and manage the earth dams</li> <li>● Friendly Policies supporting Public-Private Partnerships in water harvesting</li> <li>● Awareness and acceptance of the practice by local communities</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Private sector – access to technology, access to credit, technology installation</li> <li>● County government – capacity building, policy support, credit facilities,</li> <li>● NGOs – access to technologies, capacity building, technology installation</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Most counties are investing on water harvesting technology at community level. More is required to increase uptake by farmers in ASALs.
Counties where TIMP will be up scaled	ASAL counties; Tana River, Laikipia, West Pokot, Taita Taveta, Baringo, Turkana Garissa, Mandera, Wajir and all other counties with suitable agro-ecological settings for Onion production.,
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of awareness of the practice</li> <li>● Misconceptions of the practice</li> <li>● Difficulty in accessing target areas</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Sensitisation of target communities</li> <li>● Alternative methods of reaching target communities e.g. sensitizing and training local champions</li> </ul>
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> <li>● Potential to caution community against water scarcity</li> <li>● Improved productivity where water harvesting has been implemented.</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>● Practice will be acceptable and affordable to the communities</li> <li>● Policy frameworks friendly to support water harvesting</li> <li>● Friendly Policy environment on land tenure systems to support water harvesting</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>● Not determined</li> <li>● Not affordable to most rural households.</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>● Time saved fetching water from afar is channeled into other economic enhancing activities.</li> <li>● Money used to treat diseases related to poor water hygiene is used for other activities.</li> <li>● Healthy population will have energy to provide labour required in agricultural activities</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● The technology will save time used by women in fetching water therefore allowing them to perform other productive activities</li> <li>● Women and youth may also have limited access to finances to buy the required materials for implementation of the technology</li> <li>● Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunity exist for youth during implementation of the TIMP.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs may also have limited access to finances to buy the required the required materials for implementation of the technology.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> <li>● The technology may reduce the time and drudgery used in fetching water by the VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>● Employment opportunity exist for youth during implementation of the TIMP.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods</p> <p>A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres.</p> <p>This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.</p>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Handbook on Rainwater Harvesting and Storage Options</li> <li>● Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen</li> </ul>

F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO HQ P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email</b> : info@kalro.org
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPP

### Research GAP

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

<b>2.6.10. TIMP name</b>	<b>Conservation Agriculture (CA)</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed:	Low yields due to land degradation (declining soil fertility, low crop yields, increased soil moisture stress, increased soil erosion and loss of biodiversity).
What is it? (TIMP description)	Conservation Agriculture is a management practice intended to maximize on saving water on the farming by adhering to specific principles that target to conserve the soil, soil moisture, and soil-nutrients, and stabilize land production while reducing production costs. Conservation Agriculture principles are: (a). Minimal soil disturbance, (b). Permanent ground cover - maintenance of a mulch of carbon- rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), (c). Crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes
Justification	Land productivity is decreasing leading to decreased yield. Continuous land tilling encourages the release of GHGs (Carbon) responsible for the climate change. Conservation Agriculture (CA) has potential to conserve the soil, soil moisture, and soil-nutrients, and stabilize land production while reducing production costs.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	Agricultural shows, Mass media, Chief's Baraza, Exhibitions, Farmer field Schools (FFS), On-farm and on-station demonstrations, Field Days, Extension Officers, Digital platforms, AIPs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Training on principles and benefits of CA</li> <li>● Model demonstration using crops</li> </ul>
Partners/stakeholders for scaling up, their roles and stage of involvement	<ul style="list-style-type: none"> <li>● County Extension officers - Dissemination of information, capacity building</li> <li>● NGO's (African Conservation Network, One Acre Fund)- Capacity Building, Dissemination of information</li> <li>● CIAT, FAO – capacity building</li> <li>● County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega
Counties where TIMP will be upscaled	All other Counties with suitable agro-ecological settings for Onion production.
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Competition for crop residues with other uses like wood fuel and livestock</li> <li>● Land tenure (farmers reluctant to invest in CA where they do not have clear land rights)</li> <li>● Limited knowledge on the incremental benefits of CA</li> <li>● Limited access to CA implements</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Enhance Public Private Partnerships (PPP) to support increased production and market access</li> <li>● Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of the technology</li> <li>● Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA with agroforestry</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>● Uptake of CA technology increases with the realized incremental benefits over time</li> <li>● Continuous capacity building increases CA technology uptake</li> </ul>
Social, environmental, policy and market conditions necessary for development and dissemination	<ul style="list-style-type: none"> <li>● The practice is acceptable in target communities</li> <li>● County policies that support households investing in CA with inputs like implements</li> <li>● Market will absorb the cost of the CA practice</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase
Estimated returns	<ul style="list-style-type: none"> <li>• Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation</li> <li>• Returns on conserving soil exceeding 150 ton/hectare annually and associated increased productivity</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology may reduce women work burden when it comes to weeding.</li> <li>• Women and youth have limited rights to land for implementing CA than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• The management practice that that can be easily adopted by women.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology may reduce VMGs work burden when it comes to weeding.</li> <li>• VMGs have less rights to land in implementing CA than men.</li> <li>• VMGs have limited access to land for onion cultivation than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• The management practice that that can be easily adopted by VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	<b>References</b> <ul style="list-style-type: none"> <li>• Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya.</li> <li>• Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual</li> <li>• SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO HQ

	P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email :</b> info@kalro.org
Lead organization and scientists	KALRO, E. Mutuma
Partner organizations	County government, Private Public Partnerships

#### Research GAPS

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

1. Development of suitable CA implements/field equipment prototypes.
2. Capacity building on the benefits and operationalization of Conservation Agriculture systems – both among extension and technical staff, and at decision-making levels:

<b>2.6.11 TIMP name</b>	<b>Onion-legume intercropping</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed:	<ul style="list-style-type: none"> <li>● Decreased yields, hence low farm returns</li> <li>● Declining soil fertility, hence soil degradation</li> <li>● Soil erosion problems - runoff are minimized</li> <li>● Weeds infestation – manage using increased soil cover crops</li> <li>● Vulnerability to crop pests - practice helps slow the proliferation of pests and protect yields</li> </ul>
What is it? (TIMP description)	<p>Intercropping is the practice of growing two or more crops together. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change.</p> <p><b>Single row intercropping:</b> involves planting onions and a selected legume in alternate single rows. Spacing. The space between the two onion rows is 30cm and the legume is planted in between so that between legume and onion row is 45cm.</p> <p><b>Strip intercropping:</b> multiple rows, or a strip, of the legume is alternated with single or several rows of onions. Spacing. The inter row spacing between legume is 45cm and legume to Onion is 30 cm. The space between two onion rows is 30cm.</p> <p><b>Control of pest through intercropping</b></p> <p><b>Trap cropping,</b> this involves planting a crop that is more attractive to pests around an onion plot, thus enabling such pests to target this crop and not the onions.</p> <p><b>Repellent intercrops,</b> an intercrop that has a repellent effect to certain pests can be used. This system involved the repellent crop masking the smell of the production crop in order to keep pests away from it.</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. It offers the potential to increase yield, enhance soil fertility/biodiversity and minimize the effects of climate change. It is one of a management practice with the potential of enhancing climate change adaptation.</p> <p>The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single-crop environment.</p> <p>The practice has several advantages. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Secondly, crop mixtures frequently have lower densities of insect pests. This occurs both because the mixture confuses the insects and, if chosen carefully attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension provider, researchers
Approaches to be used in dissemination	Demonstrations, Agricultural shows, Mass media. Publications, Digital Platforms, AIPs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Awareness creation on the benefits and contribution of the practice to all stakeholders.</li> <li>● Easy access of legume varieties that are compatible with potatoes</li> <li>● Technical packages describing appropriate schedules of planting intercrop.</li> <li>● Package on fertilizer rates and regimes under the practice.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● County governments – to provide extension services, farmer mobilization and policy formulation</li> <li>● NGOs – to provide support on capacity building and micro-financing services</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Most counties in the medium to high rainfall areas and arid and semi-arid Areas
Counties where TIMP will be up scaled	All the onion growing counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Limited access and wide distribution of clean planting materials (intercrop varieties)</li> <li>● Inadequate access of technical skills on the establishment, operations and management of intercrop management practice by farmers</li> <li>● The increased effects of climate change hindering adoption.</li> <li>● Farmer high poverty levels coupled with illiteracy especially in deep rural areas of Kenya.</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions</li> <li>● Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. Use farmer field schools and demonstrations</li> <li>● Develop a comprehensive manual on the practice to guide the farmers during the adoption</li> <li>● Train local champions for effective engagement with farmers</li> </ul>
Lessons learned in up-scaling, if any	<p>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</p> <p>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.</p>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>● Socially accepted by both male and female gender.</li> <li>● The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development, dissemination	<ul style="list-style-type: none"> <li>● The technology may reduce women’s work burden when it comes to weeding.</li> <li>● Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Intercropping offers good opportunities for various gender categories e.g. men and women to grow diverse crops for economic gains.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Reduces labor demands across all gender categories.</li> <li>● VMGs have limited rights to land implementing CA than men</li> <li>● VMGs may have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Intercropping places emphasis on the importance of using available land space to grow a diversity crops thus increasing biodiversity, pest management. VMGs may benefit from the extra household income and improved nutrition.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers have reported improved soil conditions such as reduced runoff and nutrient loss, soil moisture retention 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"> <li>● 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</li> <li>● Observe careful timing of field operations (sometimes necessitating special interventions) to keep competition between the intercropped species in balance</li> <li>● A crop mix that works well in one year may fail the next if weather favors one crop over another.</li> <li>● A mixture of crops with different growth forms or timing of development may make cultivation and use of mulches more difficult and less effective</li> <li>● Planting crops in alternate rows or strips greatly simplifies management and captures some of the benefits of intercropping for pest control</li> <li>● Intercropping poses a special problem for crop rotation. This is because if plants from two families are mixed in the same bed or field, achieving a substantial duration before replanting either of those families may be difficult</li> </ul>
	<ul style="list-style-type: none"> <li>● Intercropping requires extra care and effort in planning and maintaining a viable crop rotation programme.</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling: Requires validation; Requires further research	Requires further research
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources KALRO HQ P.O. Box 57811, 00200, City Square, Nairobi, Kenya <b>Email : <a href="mailto:info@kalro.org">info@kalro.org</a></b>
Lead organization and scientists	KALRO, P. Ketiem, E. Mutuma, M. Okoti, , D. Kamau, A.O. Esilaba
Partner organizations	County governments, KCEP-CRAL project

### Research GAPS

1. Limited research on optimal levels of fertilizer use for intercropping onions and legumes – the need for site specific validation.
2. Little information on the interactions of various crop intercrops especially in the arid and semi-arid areas (ASALs).
3. Limited knowledge on resource-use efficiency particularly in regions with impoverished soils (ASALs) and economies where measured benefits is greatest.

<b>2.6.12 TIMP name</b>	<b>Mulching</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to accelerated loss of soil moisture and subsequent water stress to crops, competition with weeds, depletion of soil organic matter and salinity in ASALs).
What is it? (TIMP description)	It is the practice of covering the soil/ground with natural vegetative materials such as straw, dead leaves and compost to create favourable conditions for plant growth, development and efficient crop production. Benefits: retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose).
	 <p>Organic Mulching in Onion</p>
Justification	Mulching facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, thereby enhancing the growth and yield of onion. It minimizes weed problems, nutrient loss and raindrop impact on the soil.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● FFBS</li> <li>● On-farm demonstrations</li> <li>● Training in workshops</li> <li>● Extension publications</li> <li>● Digital platforms</li> <li>● AIPs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of plant or crop residues.</li> <li>● Awareness of the benefits of mulching</li> </ul>
Partners/stakeholders for scaling up and their roles	County government:-extension units that link farmers to various stakeholders Community farmer groups:- play coordination role for ease in problem identification and dissemination

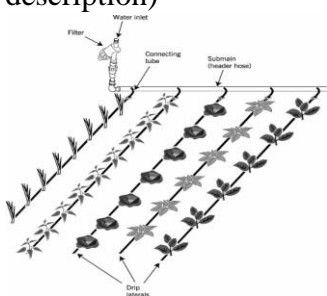
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Counties where TIMP will be promoted	All the other counties with suitable agro-ecological settings for onion production.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Multiple uses of crop residues, thus limiting the quantities available for use as mulch.</li> <li>• Possibilities of crop pest and disease pathogen build up in the soil.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Crop diversification to increase availability of residues.</li> <li>• Establish and follow a good integrated pest management program for the particular crop.</li> <li>• Adapting alternative mulching materials like high absorbance polymers.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• There is need to adopt alternative mulching technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes.</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Practice is socially acceptable</li> <li>• Environmentally is conducive for mulching</li> <li>• Increased productivity will provide supply to the markets</li> <li>• Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Mulching is labour intensive hence it may increase the labour burden for the women.</li> <li>• The TIMP will reduce women's weeding time that can be used performing other productive activities.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• The sourcing and laying down of mulch offers employment opportunities for the youths.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Since the activity is labour intensive it may increase the labour burden for the VMGs.</li> <li>• The TIMP will reduce weeding time to the advantage of the VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• The sourcing and laying down of mulch offers employment opportunities for the stronger VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	<b>User guidelines are dependent on value chain.</b> 1. Plant onions in clean seed bed 2. Apply mulch between the rows of onions. Mulch management. 3. Pull or kill weeds that grow out of the mulch. Rake the mulch occasionally to prevent it from getting packed down. Compacted mulch prevents oxygen from passing through and can starve your tree's roots. 4. Make it a point to replenish the mulch regularly to prevent weeds, provide essential nutrients, and maintain optimal drainage.
<b>F: Status of TIMP readiness</b> (Ready for upscaling: Requires validation; Requires further research)	Requires further research
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma, P. Ketieme, J. Mwaura, A. O. Esilaba, J. Wamuongo, F.M Wandera
Partner organizations	County governments Public-Private-Partnerships

**Research GAPS:**

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

<b>2.6 13 TIMP name</b>	<b>Drip irrigation systems for small scale farmers</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>Increased crop water stress and resultant low yields or crop failure, caused by seasonal rainfall variability in rain fed production.</li> </ul>

<p>What is it? (TIMP description)</p>  <p>Layout of a drip irrigation system in vegetables</p>	<p>A technology that supplements soil moisture in crop production systems. It allows the optimal usage of the limited water resource by dripping water slowly into the crop root zone at low pressure through a number of emission points (drippers).</p>
<p>Justification</p>	<p>The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. This system provides efficient fertilizer usage (fertigation) with irrigation water. Mainstreaming drip irrigation systems into crop production provides the opportunity for farmers to enhance crop resilience, increase yields and incomes.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Onion farmers, extension service providers, agro input suppliers</p>
<p>Approaches to be used in dissemination</p>	<p>Field Demonstrations, farmer field schools, ASK trade and exhibition fairs</p>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>● Correct field design (system installation) of the drip system to minimize water inefficiencies.</li> <li>● Awareness by farmers and extension providers</li> <li>● Drip irrigation system management skills</li> </ul>
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> <li>● County governments; capacity building, supportive policies and frameworks</li> <li>● Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit</li> <li>● NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology Demonstration</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted if any</p>	<p>Makueni, Bomet, Kajiado, Machakos</p>
<p>Counties where TIMP will be promoted</p>	<p>All other Counties with suitable agro-ecological settings for Onion production.</p>

Challenges in dissemination	<ul style="list-style-type: none"> <li>● Access to remote areas especially in ASAL areas</li> <li>● Language barrier in some remote areas</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>● Identify and train local champions for drip irrigation</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>● Drip system increases yield, incomes and food security</li> <li>● Linking farmers with markets is critical for enhancing sustainability</li> <li>● Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil</li> <li>● It is also important to link farmers to Micro Finance Institutions for support in installation of the drip lines.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● The practice will be acceptable I target communities</li> <li>● The water quality should be known to adjust the drip systems to avoid clogging</li> <li>● Environment will be conducive for the application of the drip irrigation</li> <li>● Policy support for increased investments in drip irrigation systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 50,000-100,000
Estimated returns	<ul style="list-style-type: none"> <li>● To be determined</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youths have less access to credit required to install drip irrigation.</li> <li>● Women have less access to technology and information on the TIMP.</li> <li>● Women have less access to education, training and extension services.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youths in installing the drip irrigation kits.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to credit required to install drip irrigation.</li> <li>● VMGs have less access to technology and information on the TIMP.</li> <li>● VMGs have less access to education, training and extension services.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youths in installing the drip irrigation kits.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● There are many successful 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.</li> </ul>

Application guidelines for users	<b>References</b> 1. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi. 2. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). <a href="http://www.fao.org/3/a-i3765e.pdf">http://www.fao.org/3/a-i3765e.pdf</a>
<b>F: Status of TIMP readiness</b> (1. Ready for Up scaling; 2. Requires validation; 3. Requires further research)	1 =Ready for up-scaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; Isaya Sijali
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirliff, and many Micro finance institutions (MFIs)

### Research GAPS

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

<b>2.6.14 TIMP name</b>	<b>Solar Irrigation for smallholder farmers</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High cost of pumping water for irrigation, using electricity of fossil fuel powered pumps
What is it? (TIMP description)	This is the sole use of solar power in the pumping of irrigation water and running of the irrigation systems

Justification	There has been general increase in prices of diesel and electricity making pumping of irrigation water to be a costly operation. Though Solar panels have been used successfully to light houses and in small businesses in the rural areas, they have hardly been used in the irrigation systems despite their potential. With efforts in addressing climate smart agriculture focusing on renewable and green energy, solar power is be a good source of this, low cost and sustainable energy.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	On-farm and on-station demonstrations Field days Training in workshops Stakeholders forums Technical releases AIPs Digital platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Documentation of available solar irrigation systems</li> <li>● Access to solar irrigation performance data.</li> <li>● Improving solar irrigation systems efficiencies in irrigation schemes</li> <li>● Creating local support for solar irrigation technologies</li> </ul>
Partners/stakeholders for scaling up and their roles	County government extension units which link farmers to various stakeholders. Community farmer groups; play coordination role for ease in problem identification and dissemination.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Various counties including Marsabit, Garissa, Machakos, Nyeri, Kajiado, Siaya, Bomet, Kericho and Uasin Gishu
Counties where TIMP will be promoted	All the 24 KSAP counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Farmers lack knowledge on the potential of solar as a power source for irrigation systems</li> <li>● High cost of innovation</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Awareness trainings on different solar irrigation systems</li> <li>● Awareness creation on advantages of solar irrigation systems pumps to governments, farmers and development agencies.</li> <li>● Capacity building of extension workers</li> <li>● Developing information packages</li> <li>● Creating solar irrigation systems network</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>● Solar irrigation systems should be well designed in water delivery, storage and application to the field.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Practice is socially acceptable,</li> <li>● Environmentally friendly,</li> <li>● Policies are friendly to the technology</li> <li>● Market will be able to absorb the extra cost and extra produce</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women and youths have limited rights to land for undertaking major investment decisions in the farm than men.</li> <li>● Women have less access to technology and information on the TIMP.</li> <li>● Women have less access to education, training and extension services.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth in installing the solar irrigation systems.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited rights to land for undertaking major investment decisions in the farm than men.</li> <li>● VMGs may also have limited access to finances to implement and operationalize the solar irrigation system.</li> <li>● VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>● Employment opportunities exist for youth in installing the solar irrigation systems.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Solar irrigation systems success stories have been reported in counties such as Kajiado on high value crops.
Application guidelines for users	<ul style="list-style-type: none"> <li>● Choose a solar irrigation system that should suit the area</li> <li>● Use efficient water application method such as drip to avoid wastage since the water is relatively low in cost.</li> </ul>
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; I.V, Sijali, M.P.O. Radiro, Francis Karanja, Fabian Kaburu

Partner organizations	Solar irrigation systems suppliers County governments National Irrigation Acceleration Programme (NIAP)
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### Research GAPS

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

<b>2.6.15 TIMP name</b>	<b>Hydroponics technology</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Declining farming land area, irrigation water scarcity, environmental pollution and low food crop and fodder productivity.
What is it? (TIMP description)	Hydroponic farming is soilless farming system that utilizes inert media as an anchor to the crop and a rich nutrient solution applied for the growth of the plant. There are various systems used but the most popular is the vertical hydroponic system. This utilizes a small area while accommodating higher crop population than the conventional method of farming. Use of locally available Soilless media such as pumice, coco peat contributes into the reduction of the cost of production such as weeding, water usage, soil analysis and more.
Justification	<p>Increased food demand for an ever expanding population amid dwindling and fragmented land sizes threatens food and nutrition security and livelihoods in Kenya. The decline in agricultural land poses a threat to sustainable food production. Implementation of alternative and intensive farming methods becomes inevitable due to increased rural urban migration in search of jobs by the youth who are more than 60% of the Kenyan population. Conventional land use is gradually becoming untenable due to escalating change of land use in high agricultural potential areas.</p> <p>Vertical hydroponic farming is a suitable technology in urban areas where people live in apartments and with micro-plots for farming space. Likewise, in areas that are not endowed with natural resources such as arid and semi -arid lands. Hydroponics farming system does not require herbicides and pesticides which persist in soil causing ill-health to humans, livestock and environment. To redress these challenges, adoption of hydroponics as an alternative farming methods will greatly boost food security.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Urban and peri-urban Farmers/youth, extension service providers, agro-input

	suppliers
Approaches to be used in dissemination	Capacity building workshops On-farm visits and excursions On-farm demonstrations and adaptive research trials Digital platforms AIPs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of affordable and quality local inert and clean planting media materials</li> <li>• Labour and expertise for installation and operation</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension services; Provide link with end consumer of the technology</li> <li>• Community leaders in case of an urban dwelling and a village leaders play coordination role for ease in problem identification.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Nairobi, Nakuru, Kakamega
Counties where TIMP will be promoted	Kajiado, Tharaka Nithi, Machakos, Kitui, Laikipia, Marsabit, Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Culture change of mind-set in some regions/cultures that the rich nutrient solution cannot support crops growth without soil.</li> <li>• Initial cost implications</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation on role of hydroponics in crop and fodder production.</li> <li>• Training and awareness crop and fodder intensification in small areas and short production span</li> <li>• Excursion training or exchange visits-- see and believe</li> </ul>
Lessons learned if any	For hydroponics to succeed, mind-set has to change
Social, environmental, policy and market conditions necessary for development and promotion	<ul style="list-style-type: none"> <li>• Practice is socially acceptable,</li> <li>• Environmentally friendly, since this is soilless farming</li> <li>• Friendly policy environment for hydroponics adoption.</li> <li>• Market able to absorb increased produce</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined
Gender issues and concerns in development, dissemination adoption	<ul style="list-style-type: none"> <li>• Women and youth may also have limited access to finances to implement and operationalize the technology</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
and scaling up	

Gender related opportunities	Employment opportunities exist for youth in installing and implementing the technology
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may also have limited access to finances to implement and operationalize the technology</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in installing and implementing the technology</li> <li>• Affirmative action in various areas, for instance in the provision of finances to VMGs</li> <li>• Increased production at household level will lead to increased consumption and utilization of onions and hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Hydroponics technologies successes have been reported in fodder and vegetables production in Muguga, Limuru –Kiambu county.
Application guidelines for users	<ul style="list-style-type: none"> <li>• Always use good quality, disease- and pest-resistant seed and planting media to ensure efficient use nutrients for vigorous growth and hence bumper production.</li> <li>• Ensure that best bet agronomic practices are upheld</li> <li>• For sustainability, proper structure maintenance and general management should be carried out as specified in the instructions manual</li> </ul>
<b>F: Status of TIMP readiness</b> 1=Ready for upscaling; 2=Requires validation; 3=Requires further research	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kabete <b>Centre Director</b> KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; E. Muriuki, F. Kaburu, David Kamau, IV Sijali.
Partner organizations	County governments Ministry of Agriculture, Livestock, Fisheries & Irrigation World Vision

## Research GAPS

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

<b>2.6.16 TIMP Name</b>	
Category (i.e. technology, innovation or management practice)	Agroforestry for soil fertility Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed:	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	This is the practice of planting trees and crops on the same land/farm, together or separately. It involves: <ul style="list-style-type: none"> <li>● Improved fallows; Leguminous trees planted in natural fallows</li> <li>● Hedgerow intercropping /alley cropping; Leguminous tree species planted in hedges</li> <li>● Green manure; biomass from growing leguminous plants that are cut at a certain height and ploughed back to the soil as source of manure</li> <li>● Mixed cropping; system of sowing two or three crops (that includes a legume) together on the same land, where one is the main crop and others are considered subsidiaries.</li> <li>● Multi-strata; an agroforestry system whose components (crops, trees, shrubs, livestock) occupy distinct layers of the vertical structure of the community.</li> </ul>
Justification	Continuous land operation continues to emit more GHGs (carbon) responsible for the climatic changes. Agroforestry with leguminous trees has potential to: <ul style="list-style-type: none"> <li>● Increase the productivity improving soil structure and protect the soil against erosion and nutrient losses by maintaining a permanent soil cover and minimizing soil disturbance.</li> <li>● Conserve soil water.</li> <li>● Enhance biodiversity.</li> </ul> Given the acute poverty and limited access to mineral fertilizers in most rural farmers in Kenya, this promising approach is one that integrates organic and inorganic fertilizers. Organic fertilizers include the use of improved fallows of leguminous trees, shrubs, herbaceous legumes and biomass transfer.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers

Approaches to be used in dissemination	Open and field days Agricultural shows, Farmer Field Schools Digital platforms, Exchange visits Demonstration plots AIPs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Sensitization on principles and benefits of agroforestry legumes for green manure</li> <li>● Model demonstration plots using cereal crops</li> </ul>
Partners/stakeholders for scaling up and their roles	County governments extension services; Community mobilization and support, Supporting frameworks/policies at the local level KALRO and KEFRI; Implementing institutions
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Machakos, Siaya, Kisumu, Kakamega, Busia, Tharaka Nithi,
Counties where the TIMP will be upscaled	All 24 KCSAP counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Limited species appropriate to different agro-ecological zones</li> <li>● Shortage of seed</li> <li>● Many farmers lack knowledge and skills needed to grow them</li> <li>● Change of mindset</li> <li>● Competing interests</li> <li>● land tenure (farmers reluctant to invest in agroforestry technologies where they do not have clear land rights)</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>● Enhance Public Private Partnerships to support increased production and market access</li> <li>● Improve county government capacity to train and re-tool technical team so as to enhance uptake of the technology</li> <li>● Availing inputs and credit</li> <li>● Allocation of more funds for continued research and dissemination of this technology would aid increased uptake agroforestry for soil fertility</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>● Mind sets of local farmers' negative about agroforestry for soil fertility improvement.</li> <li>● Inadequate skills in the technology and its management practices</li> </ul>
Social, environmental, policy and market conditions necessary	Reliable technology adoption and suitable price and market access for produce grown under the improved agroforestry system
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined

Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women and youth have rights of access to land for planting trees.</li> <li>• Women and youth may also have limited access to finances to implement and operationalize the technology.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	Employment opportunities exist for youth and women in raising seedlings for sales e.g. tree nurseries
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women and youth have rights of access to land for planting trees.</li> <li>• VMGs may also have limited access to finances to implement and operationalize the technology.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than able bodied men.</li> </ul>
VMG issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>•</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• SMEs such as tree nurseries for increased resilience and income</li> <li>• Generation</li> <li>• Employment opportunities exist for youth and women raising seedlings for sales e.g. tree nurseries</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers who adopt the technology have reported increased and sustainable source of income
Application guidelines for users	Adopters of agroforestry for soil fertility will need training to decide appropriate tree species to plant
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Kenya Forestry Research Institute, P.O. Box 20412, Nairobi <a href="mailto:jkndufa@gmail.com">jkndufa@gmail.com</a> +254 722 983238
Lead organization and scientists	KEFRI and KALRO, J. Ndufa, M. Okoti; E. Odoyo, B. Mugo
Partner organizations	County government, Private Public Partnerships

#### Research GAPS

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

## 2.7 Onion Crop Health

<b>2.7.1. TIMP Name</b>	<b>Integrated management of cutworms</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield losses and increased cost of production due to damage by cutworms
What is it? (TIMP description)	<div> </div> <p style="text-align: center;"><i>Cutworms and their damage on onions</i></p> <p>Integrated management of cutworms is an effective, economically and environmentally friendly approach. This management package safeguards the environment and improves crop yields and subsequent farm incomes. Integrated pest management involves application of a combination of physical, biological, cultural and chemical approaches. Some of the management practices included in the IPM of cutworms are; scouting for timely detection, soil solarization. Deep ploughing to expose cutworms, weeding to remove alternative hosts, solarization to destroy soil borne pests, use agri-net to exclude adult moths. In the greenhouse or in the field after transplanting use plant extracts (e.g 2 bulbs garlic:2 hot peppers) use of neem based insecticides e.g. Nimbecidine EC, Achook and Neemraj Super and biocontrol agents such as <i>Bacillus thuringiensis</i> (Bt) based products e.g. Halt WP and Thuricide HP. Other practices include:</p> <ul style="list-style-type: none"> <li>• Deep plough to remove all weeds and expose caterpillars to natural enemies and sunlight at least two weeks before transplanting.</li> </ul>

	<ul style="list-style-type: none"> <li>• In case of light infestation, dig out the damaged seedling to find and kill the cutworm.</li> <li>• Intercrop with onion, garlic, peppermint, coriander, or garlic every 10-20 rows to repel cutworms.</li> <li>• Ashes deter cutworms when spread on seed beds, around plants or mixed with soil in planting holes.</li> <li>• Use biopesticides such as Biopower 1.15 WP (<i>Beauveria bassiana</i> 1*10<sup>8</sup> cfu/ml), Nematech WG (<i>Sterinernema feltiae</i>- 1.5million infective juveniles /gram) or Nimbecidine EC (Azadirachtin 0.3 %)</li> <li>• If the biopesticides are not locally available, use Halothrin 2.5EC (Lambda cyhalothrin)</li> <li>• Use products according to the manufacturer's instructions</li> <li>• Get other products from the Pest Control Products Board List of registered products (<a href="http://www.pcpb.co.ke">www.pcpb.co.ke</a>)</li> </ul>
Justification	<p>Cutworms are a major pest of onions both in the nursery and also in the field especially during the transplanting stage. They are usually found at the base of the cut plant. They hide in the soil during the day and only emerge at night to feed on the young plants, cutting the young plant parts at the base. They sometimes cause wilting of the plant by partially cutting the plant stem. They cause considerable damage to onion seedlings by reducing crop yields and increasing costs where gapping has to be done. Timely application of IPM options results in effective control leading to higher yields of good quality onions that are free from pesticide residues.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, Extension staff, Universities, Extension Agents
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	<ul style="list-style-type: none"> <li>• An inventory of technologies that could be applied and procedures for integration</li> <li>• Availability or access to products e.g. biological control agents, bio-pesticides closer to the farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• NGOs – formation of farmers' groups in readiness for capacity building</li> <li>• Extension – capacity build the CIGs and other farmer organizations</li> <li>• Private service providers – sale of farm inputs, provision of markets for farm produce</li> <li>• Youths – form pesticide application / spraying groups</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted, if any	None
Counties where TIMPs will be upscaled	Nyeri, Mwea, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Small parcels of land hindering the uptake of some IPM options e.g crop rotation</li> <li>• Cases where farmers would not afford the pesticides</li> <li>• Where IPM components are not available they tend to use only cultural methods, and some damage might occur on the onion crop.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Training farmers on how to use the IPM options and promote conservation of biological agents to suppress various pests.</li> <li>• Consider ways of availing safer IPM strategies recommended e.g biopesticides or biological control agents through sensitization campaigns done through manufacturers, KALRO and extension staff.</li> </ul>
Lessons learned in up scaling, if any	Little experience has been gathered on the management of these pests across the onion producing regions of Kenya.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Environmental considerations on use of chemical spray options will ensure elimination of non-target organisms.</li> <li>• Biopesticides provide safer human and environmental safety options.</li> <li>• Consumers require produce that is free from pesticide residues.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Money for insecticides is a pre-requisite for incorporating chemical control as part of the IPM strategy of various pests. Cost of pesticides and labour per acre = KES 5,000
Estimated returns	2,000 kg/acre x 70/= /kg = KES 140,000 Varied for food security and income from surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	All persons are able to participatory be include in the IPM management strategies of the various pests.
Gender related opportunities	Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations.
VMG issues and concerns in development, dissemination adoption and scaling up	The management practices reduce the production costs therefore VMG's can afford to produce Onion with low-income inputs.
VMG related opportunities	The technology can improve food and nutrition security and provide a window for increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-

Application guidelines for users	<ul style="list-style-type: none"> <li>• PCPB online list of registered products</li> <li>• Integrated management of onion pests and diseases (Fact sheets produced by KALRO through KCSAP)</li> <li>• Compendium of onion diseases (SK Mohan; apsnet.org)</li> </ul>
<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-0100, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	KALRO
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> </ul>

<b>2.7.2. TIMP Name</b>	<b>Integrated management of thrips</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields and poor quality produce
What is it? (TIMP description)	<p>This is the use of a combination of strategies which include cultural, biological, physical and chemical means to control thrips. Integrated pest management is effective, economically and environmentally friendly. This will safeguard the environment and improve crop yields and subsequent farm incomes. Integrated pest management involves application of a combination of organic, inorganic, cultural approaches, physical means, biopesticides and synthetic pesticides.</p> <p>The combination of IPM practices include; scouting, crop rotation, use healthy pest free seedlings, use of agri- nets, use of plant extracts (2 bulbs garlic:2 hot peppers in 20L water)neem based biopesticides (Nimbecidine, Achook or Neemraj Super 3000) and soil solarization, during nursery preparation (deep ploughing to expose larvae and pupae,</p>

weeding to remove alternative hosts), solarization to destroy pupae before planting, mulching with grass or plastic sheets to interfere with soil life cycle stages. Agri-nets prevent thrips from entering the low tunnel nursery or greenhouse. Intercropping onions with crops such as carrot, spider plant and French bean in proximity and various combinations, Use of biocontrol product (Spinosad/Tracer 480SC), Use of blue or yellow sticky traps and weeding and managing onion residues by burying 2ft deep or burning. The goal is to produce better yield and quality on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. Intercropping allows different crops in terms of rooting, shapes, weed suppression, repulsion etc. co-exist on the same piece land.



*Thrips damage on onion (Infonet biovision)*



*Plastic mulch in onion production*

Justification


Severe thrips damage occur during dry season leading to stunted plant growth hence leading to yield reductions of 30-35% and compromise in quality. Use of IPM offers a myriad of benefits to enhance improved crop yield. This will reduce the use of chemicals thereby reducing the development of resistance that has been reported in many of the currently registered insecticides. In addition to reducing population of pests, IPM preserves beneficial insects, reduces labour costs incurred in application of pesticides, control thrips and stabilizes yields. Use of IPM in the management of thrips will result in high yields of good quality onions that are free from pesticide residues

**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	<ul style="list-style-type: none"> <li>• An inventory of technologies that could be applied and procedures for integration</li> <li>• Training of growers and TOT</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Scientists to conduct research</li> <li>• Extension agents to be trained and to promote proven control methods NGOs, &amp; private service providers to promote control methods</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of technical knowledge in thrips management</li> <li>• Limited access to effective thrips management practices</li> <li>• Over-reliance on use of fast knock down synthetic pesticides by producers with little regard for alternative options that are environmentally safe</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Create awareness on the use of biopesticides and synthetic pesticides to control thrips</li> <li>• Sensitize growers on management of thrips using non-chemical control methods e.g. proper field hygiene and yellow sticky traps biopesticides</li> <li>• Work with manufacturers of traps and biopesticides to sensitize farmers on their effectiveness through field days and demos</li> </ul>
Lessons learned in up scaling if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary for development and up scaling	Supportive policy of national and county governments to promote integrated approaches and their benefits in terms of food and environmental safety.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
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"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to information on production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• Fact sheet on Integrated Management of onion pests and diseases (KALRO/KCSAP)</li> <li>• UC Pest Management Guidelines: How to Manage Pests. Onion and Garlic Thrips. UC IPM Online. Statewide Integrated Pest Management Program. University of California. Agriculture and Natural Resources. <a href="http://www.ipm.ucdavis.edu">www.ipm.ucdavis.edu</a></li> <li>• Compendium of onion and garlic diseases and pests (SK Mohan. Apsnet.org)</li> <li>• Use of PCPB recommended environmentally friendly thrips control products as recommended by the manufacturers</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for up scaling
<b>G. Contacts</b>	

Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-0100, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organizations and scientists	KALRO: Kandara; Dr Jesca Mbaka
Partner organizations	Koppert Biological Systems, Real IPM

<b>2.7.3. TIMP Name</b>	<b>Integrated management of onion fly</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields and poor quality produce
What is it? (TIMP description)	 <p style="text-align: center;"><b>Onion fly maggots and adult fly</b></p> <p>Integrated Management of onion fly is an effective, economically and environmentally friendly approach for the control of this pest. It has the potential to safeguard the environment and improve crop yields and subsequent farm incomes. Integrated pest management involves</p>

	<p>application of a combination of organic, inorganic and cultural approaches. The combined management practices to be used included include; scouting for initial pest symptoms, use of agri-nets, use of plant extracts e.g garlic and hot pepper solution (@ 2bulbs garlic:2 hot peppers in 20L water and other biocontrol agents and soil solarization. The technology involves nursery preparation (deep ploughing to expose larvae and pupae, weeding to remove alternative hosts, solarization to destroy pupae, practice crop rotation and do not plant a new crop where an old crop was infested, agri-net to prevent onion fly from entering the low tunnel nursery or greenhouse. In the greenhouse or in the field use plant extracts (neem based insecticides e.g. Nimbecidine EC and Achook and Neemraj Super), Alphacypermethrin products (eg. Alpha cyper or Alfatox) and any other insecticide recommended by PCPB.</p>
Justification	<p>Pest infestation is favoured by cool weather conditions and soils that are rich in organic matter. Pest scouting should be done at least twice per week while observing onion maggot damage. The first generation of onion maggots primarily feeds on seedlings, up to the 3- to 5-leaf stages. The second and third generation of onion maggots will feed on the expanding bulb of the maturing plant, which can increase bulb rot during storage. Severe infestation by the onion maggot may lead to reduction of yields. Hence the use of an Integrated Management approach would lead to less losses, better quality bulbs and more income for farmers</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
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	<ul style="list-style-type: none"> <li>• An inventory of technologies that could be applied and procedures for integration</li> <li>• Training of growers</li> <li>• Training of Trainers (ToT)</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension agents- To train and promote proven control methods</li> <li>• NGOs &amp; private service providers-To promote control methods</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok

Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of technical knowledge in onion fly management.</li> <li>• Limited access to effective thrips management practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Create awareness on the use of IPM options e.g biopesticides and synthetic pesticides through collaborative efforts of stakeholders including KALRO, manufacturers, Extension staff and farmers to control the pest</li> <li>• Control of onion fly by use of non-chemical control methods e.g. proper field hygiene. Use of blue and yellow stick traps for adults</li> </ul>
Lessons learned in up scaling if any	No up-scaling carried out so far
Social, environmental, policy and market conditions necessary for development and up Scaling	<ul style="list-style-type: none"> <li>• Supportive policy of national and county governments to promote integrated approaches.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
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"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to information on production techniques There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop

<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• Integrated management of onion pests and diseases (KALRO/KCSAP fact sheets)</li> <li>• PCPB online list of registered products</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for up scaling
<b>G. Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-0100, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organizations and Scientists	KALRO: Kandara; Dr Jesca Mbaka;
Partner organizations	ICIPE, UON, IITA, UON, Egerton University

<b>2.7.4. TIMP Name</b>	<b>Integrated management of aphids</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields and poor quality produce due to infestation by aphids
What is it? (TIMP description)	<p>Integrated pest management involves application of a combination of organic, inorganic and cultural approaches.</p> <ul style="list-style-type: none"> <li>• Strategies for a successful IPM program for management of aphids include: Destruction of crop residue after harvest, use of sticky traps (yellow) to reduce pest population, regular scouting, effective weed management, use of biopesticides (Aphitech (<i>Aphidius transcaspinus</i>, a parasitic wasp), Biocatch 1.15WP (<i>Verticillium lecanii</i>), Bio-Power 1.15WP (<i>Beauveria bassiana</i> 1*10<sup>8</sup> cfu/ml), Botanigard ES (<i>Beauveria bassiana</i> starin GHA 11.3% w/w) and conservation of natural enemies by use of biological and less harmful chemical pesticides.</li> </ul>



Onions infected by aphids

Onion aphids (close up)

Justification	Aphids are serious pest of onion occurring mostly in dry season leading to stunted plant growth hence reduction of yields Aphids are vectors of many plant virus diseases. Use of IPM offers a myriad of benefits to enhance improved crop yield. This will reduce the use of chemicals thereby reducing the development of resistance that has been reported in many of the currently registered insecticides. In addition to reducing population of aphids, IPM will preserve beneficial insects, reduce labour costs incurred in application of pesticides, control thrips and stabilize yields leading to high yields of good quality onions that are free from pesticide residues
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents, Researchers
Approaches to be used in dissemination	On station and on-farm experimentation and dissemination, field days, Agricultural shows, farmer to farmer communication, leaflets, Social media
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• An inventory of technologies that could be applied and procedures for integration</li> <li>• Training of growers and ToT</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Scientist to conduct research</li> <li>• Extension agents-To train and promote proven control methods</li> <li>• NGOs, &amp; private service providers to promote control methods</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be upscaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Poor perception of aphids as a serious pest hence lack of interest in the dissemination</li> <li>• Limited resources for acquisition of inputs</li> <li>• Limited access to the selected control products such as</li> </ul>

	<p>bio-pesticides</p> <ul style="list-style-type: none"> <li>• Lack of knowledge on bio-pesticides</li> <li>• Perception that implementation of IPM programs is expensive</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Conduct training on use of biopesticides</li> <li>• Conduct trials for on farm cost benefit analysis</li> <li>• Train on the importance of IPM</li> </ul>
Lessons learned in up scaling if any	No up-scaling carried out so far
Social, environmental, policy and market conditions necessary for development and up scaling	Supportive policy of national and county governments to promote integrated approaches.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Women and youth have limited access to land for onion cultivation</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	Employment opportunities exist for youths in spraying.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Women and youth have limited access to land for onion cultivation than men.</li> </ul>
VMG related opportunities	Employment opportunities exist for youths in spraying.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None

Application guidelines for users	<ul style="list-style-type: none"> <li>● PCPB list of registered pest control products</li> <li>● Fact Sheet on Integrated Management of onion pests (KALRO/KCSAP)</li> <li>● Mishra, R.K., Jiswal, R.K., Kumar, D and Saabale, P.R. (2014). Management of major diseases and insect pests of onion and garlic: A comprehensive Review. <i>Journal of Plant Breeding and Crop Science</i> 16 (11): 160-170</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up scaling
<b>G. Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org
Lead organizations and scientists	KALRO: Kandara; Dr Jesca Mbaka
Partner organizations	Dr Jesca Mbaka

<b>2.7.5. TIMP Name</b>	<b>Integrated management of leaf miner</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields and poor quality due to damage by leaf miner
What is it? (TIMP description)	<p>Integrated pest management involves application of a combination of organic, inorganic and cultural approaches. Some of the technologies and methodologies to be used include; scouting, use of agri- nets, use of plant extracts and other biocontrol agents and soil solarization. The technology involves weeding to remove alternative hosts), agri-net to prevent leaf miners from entering the low tunnel nursery or greenhouse. In the greenhouse or in the field use the following IPM options:</p> <ul style="list-style-type: none"> <li>● Destruction of crop residue after harvesting</li> <li>● Use blue sticky traps to monitor population</li> <li>● Regular scouting of naturally occurring predators such as ladybird beetles, syrphids and parasitic wasps exert good</li> </ul>

control

- Conserve natural enemies by using compatible pesticide products
- Bio-Power 1.15WP (*Beauveria bassiana*  $1 \times 10^8$  cfu/ml), Botanigard ES (*Beauveria bassiana* starin GHA 11.3% w/w)
- Maintain a weed free environment to eliminate alternative hosts
- Use blue sticky traps to monitor adults  
(Make own from cardboard cut in sizes of 15cm X 22cm and painted blue with a hand brush)
- Cut down and destroy any alternative hosts around the desired plants
- Plough in crop remains after harvesting
- Introduce commercial natural enemies such as *Diglyphus isaea*  
sold as Diglytech (Dudutech)
- Use pesticides such as Nimbecidine EC (Azadirachtin 0.03%), Alonze 50EC (Abamectin 50g/l)
- Get other products from the Pest Control Products Board (PCPB) list of registered products ([www.pcpb.co.ke](http://www.pcpb.co.ke))



**Larva**

**Adult leafminer fly**



**Leafminer damage**

Justification	Serpentine leaf miner can cause 30 % damage if not effectively .Use of IPM offers a myriad of benefits to enhance improved crop yield. This will reduce the use of chemicals thereby reducing the development of resistance that has been reported in many of the currently registered insecticides. In addition to reducing population of leaf miner, IPM will preserves beneficial insects, reduces labour costs incurred in application of pesticides, control thrips and stabilize yields. Use of IPM in the management of leaf miner will result in high yields of good quality onions that are free from pesticide residues
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
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	<ul style="list-style-type: none"> <li>● An inventory of technologies that could be applied and procedures for integration</li> <li>● Training of growers and TOT</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Scientists to conduct research</li> <li>● Extension agents to train and promote proven control methods NGOs, &amp; private service providers to promote control methods</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of technical knowledge in leafminer management.</li> <li>● Limited access to effective leaf miner management practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Create awareness on the use of biopesticides and synthetic pesticides to control leaf miner</li> <li>● Control of leaf miner by use of non-chemical control methods e.g. proper field hygiene and blue sticky traps</li> </ul>
Lessons learned in up scaling if any	No upscaling carried out so far

Social, environmental, policy and market conditions necessary for development and up scaling	Supportive policy of national and county governments to promote integrated approaches.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>• Women and youth have limited access to productive resources such as land and farm inputs</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in spraying the crop.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and chemicals.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• Fact sheet on pests and diseases of onion and their managent (KALRO/KCSAP)</li> <li>• PCPB online list of registered products</li> <li>• Online pesticide labels</li> </ul>
<b>F: Status of TIMP readiness</b> (1- ready for upscaling;, 2- requires validation; 3-requires further research)	Ready for up scaling
<b>G. Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org
Lead organizations and scientists	KALRO

	J.Mbaka, R.Faraay, H. Odhiambo
Partner organizations	<ul style="list-style-type: none"> <li>• REAL IPM</li> <li>• Koppert Biological Systems</li> <li>• ICIPE</li> <li>• National and County Ministry of Agriculture, Livestock and Fisheries</li> </ul>

<b>2.7.6. TIMP Name</b>	<b>Integrated Management of Root Knot Nematodes</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to damage by root knot nematodes
What is it? (TIMP description)	Integrated pest management involves application of a combination of organic, inorganic and cultural approaches. Some of the technologies and methodologies to be used include; scouting, use of plant extracts and other biocontrol agents and soil solarization. Soil solarization can reduce nematode populations in the soil and levels of inoculum of many other soil borne pathogens. Use of plant resistant varieties if nematodes are known to be present in the soil.
Justification	Root knot nematodes are very persistent soil-borne pest, often causing severe yield loss as they infect new plants at the growing root tips. They have a short life cycle which makes them pests of economic importance
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, extension agents, 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	<ul style="list-style-type: none"> <li>• An inventory of technologies that could be applied and procedures for integration</li> <li>• Training of growers and TOT</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Scientists to conduct research</li> <li>• Extension agents to train and promote proven control methods</li> <li>• NGOs, &amp; private service providers to promote control methods</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	Nyeri, Machakos, Nakuru, Kajiado, Narok
Counties where TIMP will be up scaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Poor farmer perception on impact of nematodes to onion</li> <li>● Limited access to effective nematode management practices</li> <li>● Perception of implementation of IPM programs as expensive</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Do participatory experimentation of nematode IPM programs</li> <li>● Link farmers and agro-dealers to bio pesticide manufacturers</li> <li>● Conduct ToTs</li> </ul>
Lessons learned in up-scaling if any	No up-scaling carried out so far
Social, environmental, policy and market conditions necessary for development and up scaling	Supportive policy of national and county governments to promote integrated approaches.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women and youth have limited access to productive resources such as land and chemicals than men.</li> <li>● Women and youth have limited access to education, training and extension services than men</li> <li>● Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for youths and women exists in uprooting the affected crops</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and chemicals than men.</li> <li>● VMGs have limited access to training and extension services</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>● VMGs have limited access to information on production techniques</li> <li>● There is low adoption by VMGs due lack of awareness</li> </ul>

VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in uprooting the affected crops
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> <li>● PCPB list of Registered products</li> <li>● Fact sheet on onion pests and diseases (KALRO/KCSAP)</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up scaling
<b>G. Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org
Lead organizations and scientists	KALRO J.Mbaka, R. Faraay
Partner organizations	IITA, ICIPE, KEPHIS, UON, Kenyatta University, Egerton University, JKUAT

<b>2.7.7.TIMP Name</b>	<b>Integrated Management of Pink Rot disease</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields due to crop damage by pink rot disease
What is it? (TIMP description)	



Pink rot disease

This is an integrated disease management package that uses a combination of cultural, physical and chemical control measures. It involves; avoiding repeated cropping of onions on the same soil by practicing crop rotation with non-*Allium* crops (e.g beans, tomato, spinach), maintain good soil tilth for proper drainage and fertility, control insect pests that create avenues in roots that serve as entry points and other diseases to maintain healthy plants, soil solarization for 1-2 months during hot months

- Avoid repeated cropping of onions on the same soil.
- Rotating with non-*Allium* crops e.g. beans, maize, tomato etc
- Maintaining good soil tilth for proper drainage and fertility.
- Controlling insects and other diseases to maintain healthy plants. Fumigating/ solarization of the soil before planting.


Justification	Onion is a high value crop that takes relatively shorter time (4 months) and with high returns. The impetus use of synthetic pesticides have not only caused disease resistance, but has also compromised food safety due to excess chemical residues consumption, hence the importance of using an integrated approach that is human and environmentally safe in managing Pink Rot disease
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**B: Assessment of dissemination and scaling up/out approaches**

Users of TIMP	Farmers (large-scale and small scale)
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Participatory training of farmers and extension officers on GAPs</li> <li>• On-farm experimentation and demonstration</li> <li>• Extension materials (posters, brochures, leaflets, factsheets, manuals)</li> <li>• Plant health clinics and plant doctors</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Crop rotation</li> <li>• Proper watering mechanism to avoid splashing of disease</li> <li>• Treatment of the soil</li> </ul>

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Farmers- to provide land for research and demonstrations</li> <li>• County agricultural extension officers-To mobilise farmers and participate in training of trainers</li> <li>• Researchers-to conduct research, backstop ToTs</li> <li>• NGOs/CBOs-to mobilize farmers, participate in monitoring and evaluation</li> <li>• Seed Companies to provide high quality seed of superior varieties</li> <li>• Farm input suppliers-To provide farm inputs (seed, fertilizers, pest control products)</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru, Kajiado, Nyeri
Counties where TIMPs will be up scaled	Pokot, Bungoma, Taita Taveta, Narok
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Low adoption of the technology due to low sensitization</li> <li>• Rearing and availability of the biocontrols can be a big challenge to the adoption of the technology.</li> <li>• Lack of enough funds to enable the expertise to reach at farm level</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Information dissemination - GAPs</li> <li>• Scaling up participation of end-user through on farm activities on the technology done research/extension activities</li> <li>• Promoting awareness among farmers about the effects of chemical use on human health and the environment</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>• Farmers want quick fix biocontrol technologies that are effective and specific</li> <li>• Wrong application techniques of the technology hence creating perception that the technology doesn't work</li> <li>• Farmers are not practicing integrated pest management thus leading to low production and low quality yields</li> <li>• Creating awareness to farmers increases adoption of technologies</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Reduced use of chemicals by adopting environmental friendly approach</li> <li>• Production of high quality produce that guarantees food quality and safety and longer shelf life</li> <li>• Availability of farm produce that is free from chemicals</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not Determined
Estimated returns	Not Determined


Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● Women and youth have limited access to productive resources such as land and chemicals than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for youths and women exist in uprooting the affected crops.</li> </ul>
VMG issues and concerns in development and dissemination and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and chemicals than men</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to information on production techniques</li> <li>● There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for unemployed youths and those recovering from drugs exist in uprooting the affected crops.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
Application guidelines for users	<ul style="list-style-type: none"> <li>● PCPB list of Registered products</li> <li>● Fact sheet on onion pests and diseases (KALRO)</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation 3. Requires further research)	Requires further research
<b>G: Contacts</b>	
Contacts	KALRO
Lead organization and scientists	<p>Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org</p> <p>Mbaka, J., Amata R., Otipa M., Too A, Wasilwa, L.</p>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● Egerton University</li> <li>● Greenhouse suppliers</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Private sector players for access to improved seed (agro-dealers and stockists)</li> <li>● Input suppliers</li> </ul>

<b>2.7.8.TIMP Name</b>	<b>Integrated Management of downy mildew (<i>Peronospora destructor</i>) in onion</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Heavy crop loss up to 70% due to downy mildew
What is it? (TIMP description)	<div style="text-align: center;">  <p><b>Downy mildew symptoms on leaves</b></p> </div> <p>An integrated approach to effective management of downy mildew involves: use of seedlings raised from certified seed of a superior variety, destruction of plant debris by burning, observing a 3 year crop rotation with a non-<i>Allium</i> species crop, recommended spacing and use of drip irrigation</p>
Justification	Since downy mildew of onion is a serious disease causing 70% loss, there is need to disseminate an effective disease management strategy. Integrated disease management involves a set of principles to effectively manage disease .These include: selecting a site where disease has not been reported, planting healthy seedlings, establishing disease economic thresholds, crop and field hygiene, use of environmentally disease control products such as bio-pesticides (Trichoderma based)and use of conventional fungicides from the PCPB list of registered Pest control products
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers (large-scale and small scale)</li> <li>● Seed companies</li> <li>● Research institutions</li> </ul>

Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Participatory training of farmers and extension officers on GAPs</li> <li>● On-farm experimentation and demonstration</li> <li>● Extension materials (posters, brochures, leaflets, factsheets, manuals)</li> <li>● Plant health clinics and plant doctors</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of resources</li> <li>● Adoption of the technology by farmers</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers-To participate in dissemination activities, offer land and labour for experimentation and demonstration plots</li> <li>● County agricultural extension officers-To mobilise farmers, offer extension services, participate in ToTs and policy formulation and enforcement</li> <li>● Researchers-Establishment of demonstration plots and coordination of farmer trainings</li> <li>● NGOs/CBOs- Farmer recruitment and mobilization, Capacity building, M&amp;E</li> <li>● Farm input suppliers- Provision of the seed, fertilizers, pest control products</li> <li>● Bio pesticide manufacturers –To train on the use and handling of bio pesticides</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Trials done at research stations.
Counties where TIMPs will be upscaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Inadequate service providers</li> <li>● Expertise</li> <li>● Inadequate resources</li> <li>● Weak research-extension-farmer linkages</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Information dissemination – GAPs</li> <li>● Scaling up participation of end-user through on farm activities on the technology done research/extension activities</li> <li>● Promoting awareness among farmers about the effects of chemical use on human health and the need to adopt cultural methods</li> <li>● Encourage more participation of NGOs/private partnerships</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Availability of cost benefit information enhances adoption</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● The technology requires adequate sensitization since cultural practices against diseases are not in much use by farmers.</li> </ul>

	<ul style="list-style-type: none"> <li>• Need to use environmentally friendly products</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Cost : benefit ratio of 1:3.05
Estimated returns	Higher bulb yield of 13.81 t/ha

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to productive resources such as land and chemicals than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for youths and women exist in uprooting the affected crops.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and chemicals than men.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to information on production techniques.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for unemployed youths and those recovering from drugs exist in uprooting the affected crops.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Currently there are a few red onion cultivars that are resistant to downy mildew</li> <li>● Spores can travel in moist air but can be quickly killed by dry conditions</li> </ul>
Application guidelines for users	Fact sheet on integrated management of diseases of onion (KALRO/KCSAP)
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validationv 3. Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contact	<p>Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org</p> <p>Mbaka, J.,V., Amata R., Too, A., Wasilwa L.,</p>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● KALRO</li> </ul> <p>Mbaka, J., Ochieng V., Amata R., Too A, Wayua F., Wasilwa L.,</p>
Partner organizations	<ul style="list-style-type: none"> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Private sector players for access to improved seed (agro-dealers and stockists)</li> <li>● Plant doctors</li> </ul>

Category(i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Losses caused by onion purple blotch
What is it? (TIMP description)	 <p style="text-align: center;"><b>Purple blotch</b></p> <p>Integrated management of purple blotch in onion involves: Use of healthy seedlings, use of resistant varieties, crop and field hygiene, use of GAPs, effective weed management to remove disease alternate hosts and as a last resort, use of fungicides from the PCPB list of recommended pest control products.</p>
Justification	Yield losses due to purple blotch can go as high as 50% if the disease is not effectively managed. Cost of production is increased by use of pesticides for disease control hence reduction in profit margins. There is need to use an integrated approach to reduce losses and improve quality yields
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers</li> <li>● Researchers</li> <li>● Extension Agents</li> <li>● Input suppliers</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstrations</li> <li>● Field and open days</li> <li>● Training of Trainers</li> <li>● Farmer Field and Business Schools (FFBS)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Start remedial measures immediately after the first signs appear.</li> <li>● When using a pesticide (even a botanical home-brew), always wear protective clothing. Follow the instructions on the product label, such as dosage, timing of application, pre-harvest interval, maximum number of sprays, restricted re-entry interval. Do not empty into drains.</li> <li>● Always consult recent list of registered pesticides (PCPB)</li> </ul>

Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>● Farmers-To participate in dissemination activities, offer land and labour for experimentation and demonstration plots</li> <li>● County agricultural extension officers-To mobilise farmers, offer extension services, participate in ToTs and policy formulation and enforcement</li> <li>● Researchers-Establishment of demonstration plots and coordination of farmer trainings</li> <li>● NGOs/CBOs- Farmer recruitment and mobilization, Capacity building, M&amp;E</li> <li>● Farm input suppliers- Provision of the seed, fertilizers, pest control products</li> <li>● Bio pesticide manufacturers –To train on the use and handling of bio pesticides</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions
Counties where TIMPs will be up scaled	Bungoma, Taita Taveta, Kajiado, Narok Isiolo
Challenges in Development and dissemination	<ul style="list-style-type: none"> <li>● Inadequate service providers</li> <li>● Expertise</li> <li>● Inadequate resources</li> <li>● Weak research-extension-farmer linkages</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Information dissemination – GAPs</li> <li>● Scaling up participation of end-user through on farm activities on the technology done research/extension activities</li> <li>● Promoting awareness among farmers about the effects of chemical use on human health and the need to adopt cultural methods</li> <li>● Encourage more participation of NGOs/private partnerships</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Availability of cost benefit information enhances adoption</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● The technology requires adequate sensitization since cultural practices against diseases is not in much use by farmers. Need to use environmentally friendly products.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Cost : benefit ratio of 1:3.05
Estimated returns	Higher bulb yield of 13.81 t/ha
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to productive resources such as land and chemicals than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for youths and women exists in uprooting the affected crops.</li> </ul>
VMG issues and concerns in	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and chemicals than men.</li> </ul>

development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to information on production techniques.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for unemployed youths and those recovering from drugs exists in uprooting the affected crops.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Stories of individual farmers
Application guidelines for users	Fact sheet on integrated management of diseases of onion (KALRO/KCSAP)
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: Director.hri@kalro.org
Lead organization and scientists	KALRO M. Otipa, J. Mbaka, A. Too, G. Ongoya
Partner organizations	MoA, JKUAT, Dudu Tech, Koppert Biological Systems

<b>2.7.10.TIMP Name</b>	<b>Integrated Management of Xanthomonas leaf blight in onion</b>
<b>Category (i.e. technology, innovation or management practice)</b>	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield losses due to leaf blight caused by the bacteria <i>Xanthomonas</i> spp.
What is it? (TIMP description)	Integrated management of bacterial leaf blight in onion involves: Use of healthy seedlings, use of resistant varieties, crop and field hygiene, use of GAPs, effective weed management to remove disease alternate hosts. No chemicals are recommended for control of bacterial diseases in Kenya but copper based fungicides can be used to slow bacterial multiplication hence disease severity.
Justification	When conditions for disease development are favourable for <i>Xanthomonas</i> leaf blight, all leaves may become completely blighted leading to plant death. This may result to 100 % crop loss. There is no single effective method for management of bacterial diseases hence and integrated approach includes hence the need for an integrated management approach.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers (large-scale and small scale)</li> <li>● Seed companies</li> <li>● Research institutions</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>● Participatory training of farmers and extension officers on GAPs</li> <li>● On-farm experimentation and demonstration</li> <li>● Extension materials (posters, brochures, leaflets, factsheets, manuals)</li> <li>● Plant health clinics and plant doctors</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of resources</li> <li>● Adoption of the technology by farmers</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers-To participate in dissemination activities, offer land and labour for experimentation and demonstration plots</li> <li>● County agricultural extension officers-To mobilise farmers, offer extension services, participate in ToTs and policy formulation and enforcement</li> <li>● Researchers-Establishment of demonstration plots and coordination of farmer trainings</li> <li>● NGOs/CBOs- Farmer recruitment and mobilization, Capacity building, M&amp;E</li> <li>● Farm input suppliers- Provision of the seed, fertilizers, pest control products</li> <li>● Bio pesticide manufacturers –To train on the use and handling of bio pesticides</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Trials done at research stations.
Counties where TIMPs will be up scaled	Major onion growing areas in Kenya: Kieni, Bungoma, Isiolo, West Pokot, Bungoma, Taita Taveta, Narok
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Inadequate service providers</li> <li>● Expertise</li> <li>● Inadequate resources</li> <li>● Weak research-extension-farmer linkages</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Information dissemination – GAPs</li> <li>● Scaling up participation of end-user through on farm activities on the technology done research/extension activities</li> <li>● Promoting awareness among farmers about the effects of chemical use on human health and the need to adopt cultural methods</li> <li>● Encourage more participation of NGOs/private partnerships</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Availability of cost benefit information enhances adoption</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● The technology requires adequate sensitization since cultural practices against diseases is not in much use by farmers. Need to use environmentally friendly products.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Cost : benefit ratio of 1:3.05

Estimated returns	Higher bulb yield of 13.81 t/ha
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth have limited access to productive resources such as land and chemicals than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	Opportunities for youths and women exists in uprooting the affected crops
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and chemicals than men.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to information on production techniques.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities for unemployed youths and those recovering from drugs exists in uprooting the affected crops</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Currently there are a few red onion cultivars that are resistant to downy mildew</li> <li>● Spores can travel in moist air but can be quickly killed by dry conditions</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Onion Diseases Hand out: USDA Phytosanitary project 2014</li> <li>● Kuria, S. and Kihara, S. (2016). Onion Diseases. KALRO HRI Brochures</li> <li>● Fact sheet on Pests and Diseases of onion and their management (KALRO/KCSAP)</li> <li>● Compendium of onion and garlic. <a href="http://apsjournal.apsnet.org">apsjournal.apsnet.org</a></li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	KALRO J. Mbaka, V. Ochieng, R. Amata , L. Wasilwa
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Private sector players for access to improved seed (agro-dealers and stockists)</li> <li>● Plant doctors</li> </ul>

<b>2.7.11.TIMP Name</b>	<b>Onion Integrated Weed Management (IWM)</b>
Crop management practices	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to competition for nutrients and sunlight with weeds, increased pest and disease incidence due to presence of alternative weed hosts, high cost of weed, pest and disease control leading to reduced profits
What is it? (TIMP description)	<p>Integrated Weed Management (IWM) is the management of weeds using two or more approaches including preventive, land preparation and tillage (physical), use of biodegradable or synthetic mulch, cultural, biological control, and chemical control depending on the weeds infestation.</p> <p>Physical control is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks). Biological control is where you graze animals. Chemical control is where appropriate recommended herbicides are applied to control weeds. Chemical weed management may involve use of pre-emergence selective herbicides or post-emergence selective herbicides. Or pre-plant soil incorporated.</p>
Justification	Integrated pest management is affordable, reliable and sustainable in management of weeds. The wide choice of options allows the farmer to choose what is suitable in their condition depending on type of weed, crop, income level and size of land.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension workers, Agro dealers
Approaches used in dissemination	Demonstrations and field days. Media (Online), manuals, pamphlets.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Address environmental and safety concerns related to the use of herbicides</li> <li>● Accompany the promotion with demos and field days with farmer groups and stakeholders on the effectiveness of the various weed management options using FFSB approach.</li> <li>● Train users on appropriate use of herbicide and safe use.</li> <li>● Train stakeholders on biology of weeds and weed dynamics in cropping systems.</li> <li>● Farmers need training on timing with regard to conservation of biodiversity.</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>● KALRO-to conduct on station and on farm research</li> <li>● Farmers to offer land and labour for demonstration plots</li> <li>● Agro-Chemical Companies to sell herbicides</li> <li>● County Departments of Agriculture to mobilize farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All onion growing Counties in Kenya

Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● High cost of herbicides</li> <li>● Inadequate knowledge and information on which herbicides to use, when to use them and their persistence in the soil.</li> </ul>
	<ul style="list-style-type: none"> <li>● Myths on appropriateness of using herbicides</li> </ul>
Suggestion for addressing the challenges	<ul style="list-style-type: none"> <li>● Promotion of the product by conducting demos and field days and involvement of the stakeholder e.g. agro-chemical company.</li> <li>● Develop and disseminate information to various stakeholders.</li> <li>● Training on integrated approaches using available methods, including appropriate herbicides for onions.</li> <li>● Their persistence in different soil environment that can affect follow up crops in rotation as a result of residues or carryover.</li> <li>● Safe use of herbicides.</li> </ul>
Lesson learned in up scaling if any	<ul style="list-style-type: none"> <li>● That integrated approaches of weed management are more effective and environmentally friendly.</li> <li>● Continuous use of herbicide is an environmental, health and social hazard.</li> <li>● 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.</li> <li>● Consumers are concerned about herbicide residues in onions</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Training on integrated weed management</li> <li>● Formulation of an environmental and safety plan for herbicides.</li> <li>● Addressing the environmental and social concerns related to use of agrochemicals.</li> <li>● Formation of a functional agro dealer network to supply the products when required by the farmers.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh 4000
Estimated returns	KSH 1000 per acre
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● Since weeding for onion is mostly done by women and children, dissemination strategies should target women more but also take care of men by sensitizing men so they become aware of the TIMP.</li> </ul>
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>● Make all gender understand the benefits of IWM.</li> <li>● Empower both men and women to make a judicious decision on IWM approach.</li> <li>● Use of IWM technology can reduce drudgery from manual weeding and save time for other activities to women</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Labour is reduced therefore opportunities exist for women and youth to get in other economic activities including the production and marketing.</li> </ul>
Vulnerable and marginalized groups (VMG) issues and concerns in development, adoption, scaling	VMG groups could be having limitations in accessing the knowledge, resources and have been exposed to many threats, such as insecurity and land disputes.
VMG related opportunities	Training VMG on IWM practices and opportunities
<b>E: Case studies/profiles of success stories</b>	

Success stories	
Application guidelines for users	Extension and training material available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling. 2. Requires Validation..3.Requires further research)	Ready for up scaling
<b>- G: Contacts</b>	
Contacts	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	KALRO, Kabete- Dr Hottensiah Mwangi.
<b>2.7.11.TIMP Name</b>	<b>Herbicide Weed Control</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield losses due to heavy weed infestation and competition with onions crop.
What is it? (TIMP description)	Chemical weed control refers to any technique that involves the application of herbicide to weeds or soil to control the growth or germination of the weed species. Herbicide weed control is a technology that requires knowledge on herbicides required for specific crop (onion).
Justification	Manual hand weeding is very labour intensive, and onions have shallow roots easily damaged by mechanical weed control tools and are grown with high densities that make it difficult for mechanical implements to pass through. Use of herbicides reduces drudgery, allows timely weed control and is profitable.
Region promoted	Limited use of herbicide among small scale farmers
Counties where TIMP will be upscaled	Herbicide weed control can be up scaled in all the areas where onions grow.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, and training on safe use of chemicals.
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"> <li>● Public and private partners –[MOALF&amp;I] for extension,</li> <li>● Chemical companies for back stopping.</li> <li>● Farmer Input Promotions (FIPs) for promotion.</li> <li>● FIPs (Farmer Input Promotion) for promotion.</li> </ul>

	<ul style="list-style-type: none"> <li>● Farmer Groups for activity implementation and promotion.</li> <li>● Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>● 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.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Limited knowledge and information and low literacy levels among the farmers.</li> <li>● Herbicide use and application requires knowledge and training for effective and safe of herbicides.</li> <li>● The farmers need to understand the proper use and application of herbicides to avoid buying the inappropriate herbicides.</li> </ul>
<b>Recommendations for addressing the challenges</b>	
Lessons learned	<ul style="list-style-type: none"> <li>● There is need to train the agricultural extension county officers as TOTs on safe use of herbicides.</li> <li>● This will help in reaching the farmers with the information.</li> <li>● Herbicides like all chemicals have to be used with care to avoid environmental, health and social hazards.</li> <li>● Liaise with the Agricultural extension and environmental officers on the ground for guidance on safe use of chemicals.</li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and safe use of herbicides is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Herbicide use is cheaper than manual weed control because it requires less labour.
Estimated returns	Not determined
Gender issues and concerns in development and Dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women perform most of the crop production activities such as weeding hence the IWM may increase their work burden.</li> <li>● Women and youth have limited access to productive resources such as land and chemicals.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and men in spraying.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males in spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	Onion growing regions in Kieni, Kirinyaga, Bungoma, West Pokot, Kajiado and Kitengela

Success stories	.
Application guidelines for users	<ul style="list-style-type: none"> <li>● Fact sheet on weed management of onion and their management (KALRO/KCSAP)</li> <li>● Information and instructions always displayed on the labels attached to container on how to use.</li> </ul>
F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires Validation; 3. Requires Research )	Requires validation and more research
G: <b>Contacts</b>	Institute Director, Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:Director.hri@kalro.org">Director.hri@kalro.org</a>
Lead organization and scientists	KALRO Hotensia Mwangi, J.Mbaka, and Violet Momanyi
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County governments, Universities

### Research GAPS

1. Create awareness among farmers on safe use of pesticides, effects of pesticides on human and environment and disposal of pesticides in the project target areas
2. Form surveillance youth or women groups to assist farmers identify pests and disease and start management options on time to reduce overuse of the pesticides
3. Capacity build youths and men to form spray teams in each ward/county
4. Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management
5. Establish Plant Clinics where by farmers can visit and be helped
6. Train Agro dealers in pest and disease diagnosis and management options to empower them assist the farmer
7. Work closely with AAK and establish aggregations centres for collection and incineration of pesticides
8. Evaluation of bio pesticides and bio fertilizer to provide alternatives to synthetic pesticides

<b>2.7.13. TIMP Name</b>	<b>Weed management by intercropping in onion System</b>
Categories (i.e. technology innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addresses	High incidence of difficulty to control annual and perennial grass and broadleaved weeds combined with poor weed management lead to high production costs, low and poor quality yields in onion.

What is it? (TIMP description)	Intercropping system is the growing of two or more crops in a field at the same time as a means to enhance agricultural production, obtain efficient land use and manage weeds by reducing weed area. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. Appropriate legume crops such as beans, <i>dolichos lab lab</i> and <i>mucuna puriens</i> are planted in between rows of onion while ensuring the right spacing. There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Arrangement crops may be staggered 1-by-2 or 2-by-2 configuration between other crops. More complex intercropping systems with more than 2 crops have also been tested.
Justification	Planting specific selected legume crops such as beans, <i>dolichos lab lab</i> and <i>mucuna</i> in between onion rows effectively controls or reduces weed density in the crop. The canopy of the legumes form a physical barrier that prevents light from reaching weed seedling thus hindering their growth, and also germination of new weed seeds. These decreases weed population density and biomass yield thereby reducing weeding costs. Intercropping significantly increases total productivity as compared to mono cropping because of better utilization of water, nutrients and solar energy. Crops in this system use available resources more efficiently because they have different rooting and canopy properties which exploit resources from legumes that fix nitrogen, or make available inorganic phosphorus in the soil.  Success of intercropping systems over mono cropping can be achieved by timely planting, plant density, available resources and intercropping patterns. Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Agents, Researchers
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Conduct demos and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>● County extension staffs, NGOs, Seed Companies- Extension and dissemination of information</li> <li>● Research organizations (KALRO, JKUAT, Egerton University)- Further Research and dissemination</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Altitude areas of 0-1900 above sea level ie
Counties where TIMPs will be up scaled	Nyeri and Laikipia
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	Facilitation of training of county extension staffs Contact demos and field days

Lesson learned in up scaling if any	Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promoting in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not determined
Estimated returns	Not determined
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities such as weeding hence the IWM may increase their work burden.</li> <li>• Women and youth have limited access to productive resources such as land and chemicals.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit and quality seed.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Murang'a
Application guidelines for users	Extension and training material available
<b>F: Status of TIMP Readiness</b> (1. Ready for up Scaling; 2. Requires	Require validation

<b>2.7.14. TIMP name</b>	<b>Use of Mulch for weed management in onion</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields due to weed infestation, decreasing soil moisture and organic matter in ASALS

What is it? (TIMP description)	<p>Mulching is the practice of covering the soil/ground with natural or synthetic materials. Mulches can effectively control weeds from seeds that germinate near or at the soil surface. Biodegradable mulches include straw, dead leaves and compost which make more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Black nondegradable or synthetic mulches are used to control weeds in onions.</p> <p>Benefits: Organic mulches retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose) and improve microclimate hence increasing biodiversity.</p> <p>Synthetic mulches will solarize soils, control weeds and weed seeds, retain soil moisture and control diseases.</p>
Justification	<p>Organic mulching adds benefits other than minimizing weed infestation, facilitates retention of soil moisture and helps in controlling temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity.</p> <p>Synthetic mulches are easy to obtain and apply, and are reusable.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Researchers, Extension Workers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field schools</li> <li>● On-farm demonstrations during farmer field schools</li> <li>● Training in workshops</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of plant or crop residues for organic mulches</li> </ul>
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>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Murang'a
Counties where TIMP will be promoted	Where onions are a priority value chain.
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of enough plant and crop residues due to competing uses of organic mulches.</li> <li>● Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Crop diversification to increase availability of organic mulches.</li> <li>● Establish and follow a good integrated pest control management program for the particular onions.</li> <li>● Adapting alternative mulching materials like high absorbance polymers in onion.</li> </ul>

Lessons learned	There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>● Practice is socially acceptable</li> <li>● Environmentally friendly</li> <li>● Increased productivity will provide supply to the markets</li> <li>● Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land and credit that can be used for onion farming than men.</li> <li>● Women have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● 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.</li> <li>● Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land and credit for onion farming.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Intercropping offers good opportunities to VMGs to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

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

<b>2.7.16. TIMP Name</b>	<b>Mechanical weeding</b>
Category (i.e. technology, innovation or management practice)	Management
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield losses due to competition for nutrients by weed
What is it? (TIMP description)	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. 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.  Delay in weeding which may result into weed take over resulting in severe competition with the onion should be avoided. The right tools for weeding are used to avoid shock-stress on onion due to disturbance and root damage since the young crop is very sensitive. The intra row weeds can also be removed by hand pulling.
Justification	Weeds will cause yield losses due to competition if not controlled, harbour other pests (insects and diseases) and interfere with harvesting.

Region promoted	All areas where onions are grown.
Counties where TIMP will be upscaled	All counties growing onions.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and Agricultural extension officers.
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	Participatory Implementation, stakeholder sensitization
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Public and private partners –[MOALF&amp;I] for extension,</li> <li>● Jua Kali artisans-Develop mechanized implements</li> <li>● 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.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Challenges in dissemination	Implements not readily available in the market.
Recommendations for addressing the challenges	Work with Jua Kali industries for fabrication of appropriate implements.
Lessons learned	Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities technologies and management on the available practices in weed
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Basic cost of the weeding implement (implement is high -28,000 for ordinary bean farmers, they can purchase as a group.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination. Adoption and up scaling	<ul style="list-style-type: none"> <li>● Women perform most of weeding activities so the TIMP will reduce their work burden.</li> <li>● Women and youth have less access to land than men.</li> <li>● VMGs have limited access to education, training and extension services.</li> <li>● Women have less access to technology and information.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit</li> </ul>
VMG issues and concerns in development and dissemination, adoption and up scaling	<ul style="list-style-type: none"> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● VMGs have limited access to education, training and</li> </ul>

	<p>extension services.</p> <ul style="list-style-type: none"> <li>VMGs have less access to land for onion cultivation.</li> </ul> <p>VMGs have limited access to education, training and extension services</p>
VMG related opportunities	Affirmative action opportunities exist for VMGs to access the required credit.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Production manuals to include weed management TIMPs.
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Validation 3. Requires further research)	1) Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, H. Mwangi and V. Momanyi
Partner organizations	MoALF in Counties

<b>2.7.1.6. TIMP Name</b>	<b>Safe Use of herbicides</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Excessive use, inappropriate application and handling of herbicides.
What is it? (TIMP description)	Capacity building of farmers, crop protection 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. The technology will include proper methodologies for proper herbicide disposal to minimize pollution of the environment.
Justification	Although cases of improper use of pesticides are very common in most of the areas where onion is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users to be made aware of the best practices that should be used when handling pesticides. There has been reports of increase of chronic diseases in human beings.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	


Users of TIMP	Farmers, onion Producers
Approaches used in dissemination	Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, Pesticides spray Demonstrations.
Critical/essential factors for successful promotion	Collaboration between all partners, willingness of farmers to adhere to proper guidelines. Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Ministry of Agriculture Extension Service - To conduct extension services and farmer trainings,</li> <li>● Individual Farmers, farmer groups/CBO- To participate in the implementation of the various technologies for maize production, KALRO and Universities- To develop the technologies and conduct ToTs.</li> <li>● AAK, PCPB, KEPHIS- Dissemination of information</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where technology is already being promoted if any	-
Counties where TIMPS will be up scaled	All Onion growing counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Change of mindset in favour of current practices maybe difficult to achieve.</li> <li>● Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of herbicides.</li> <li>● Use of banned pesticides from neighboring countries</li> <li>● Inadequate capacity for farmers and agrochemical companies to dispose herbicides (pesticides) properly</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Capacity building and sensitization forums for both farmers and agro dealers using participatory approach.</li> <li>● Formation of youth spray teams.</li> <li>● Establishment of aggregation centres for pesticide containers</li> <li>● Establishment of training of Extension staff and lead farmers as TOT.</li> <li>● Increase surveillance along the border points and enforce the laws.</li> </ul>
Lessons learned in upscaling if any	Upscaling of this technology needs young men and youth 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. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.
Social, environmental, policy and market conditions necessary	Organized collective marketing channels critical for benefits to be derived from practice
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not determined
Estimated returns	Not determines

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities such as weeding hence the TIMP may increase their work burden.</li> <li>• Women and youth have limited access to land for onion farming.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in mechanical weeding.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for onion farming.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in mechanical weeding</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to herbicides.</li> <li>• Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms.</li> <li>• Safe use of Pesticide campaigns by AAK, PCPB KALRO and MOLF&amp;I have</li> </ul>
Application guidelines for users	Manuals and brochures developed by KALRO and CABI as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling
<b>F: Contacts</b>	
Contacts	Centre Director, KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. <u>Tel:+254-0721822312</u> E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO H. Mwangi and V. Momanyi.
Partner organizations	MoALF&I, PCPB, AAK, KEPHIS, County Governments, Universities

## 2.8 Post-Harvest Management

<b>2.8.1 TIMP Name</b>	<b>Harvesting onions</b>
Category (i.e. technology, innovation or management practice)	Management Practice

<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Post-harvest losses due to decay, bruises and microbial infections
What is it? (TIMP description)	Post-harvest management involves observance of maturity index, culling, proper drying of produce, actual harvesting, transportation and packaging.
	<p><b>Maturity indices</b></p> <p>Bulb onions are ready for harvest when:</p> <ul style="list-style-type: none"> <li>● They are 3 months after transplanting</li> <li>● 75% of the tops turn brown / yellow, fall over and dry.</li> <li>● Leaves start to turn yellow and the skin becomes papery around the bulb.</li> <li>● Foliage wither and form a shiny membrane cover around the bulb</li> <li>● The neck of the onion is dry and tight, and silver skin peels off easily</li> <li>● 50% of the bulb is exposed out of the soil, also called <i>neck fall</i>.</li> <li>● Pinching the neck of the growing onion. For immature onions, the necks are stiff, whereas mature onions have soft necks.</li> </ul> <p><b>Green leaf onions</b> can be harvested:</p> <ul style="list-style-type: none"> <li>● During thinning after 45-60 days from planting and used as salads</li> <li>● Done when leaves begin to turn yellow and bulbs are firm</li> <li>● When 100% bend over</li> </ul> <p><b>Pre-harvesting Operations</b></p> <ul style="list-style-type: none"> <li>● When the bulbs start forming, ensure the bulbs are covered with soil to minimizing sun scalding.</li> <li>● Check the progress of the onions regularly and remove soft and /or rotten bulbs.</li> </ul> <p><b>Harvesting</b></p> <ul style="list-style-type: none"> <li>● Manual harvesting is the most common practice in Kenya. This is carried out by levering the bulbs with a fork to loosen them and pulling the tops gently by hand to avoid bruises.</li> <li>● Harvested bulbs are left in the field for 2-3 days before bringing them to the curing house.</li> <li>● To prevent sun-scald, lay the tops of one row over the bulbs of another.</li> <li>● However, if rain occurs, the bulbs should be brought to the curing house immediately.</li> <li>● Harvest during hot and sunny days. Harvesting when it is raining increases chances of rotting</li> <li>● Late harvesting is likely to cause excessive sprouting during prolonged storage.</li> </ul>

	 <p style="text-align: center;"><i>Onions in a farm</i></p>
Justification	Inappropriate timing of harvesting and inappropriate harvesting practices lead to rotting and postharvest losses of onions
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers (small-scale and large scale farmers, with open fields and/or greenhouses)</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures, leaflets and manuals</li> <li>● Seminars to create awareness</li> <li>● ICT (WhatsApp groups, websites, mobile apps)</li> <li>● Open days</li> </ul>
Critical essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Application of all GAPs in onion production (e.g. timely harvesting, correct harvesting, cleaning of the harvested onion before curing)</li> <li>● Participatory Implementation, stakeholder capacity building and networks.</li> <li>● Creating awareness on effects of improper post-harvest handling</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion</li> <li>● Extension service (public and private) – technology transfer and dissemination</li> <li>● Researchers (KALRO, Universities) – establishment of demonstration plots, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – up-scaling of technologies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	<ul style="list-style-type: none"> <li>● Onion growing regions in Nyeri, Kirinyaga, Bungoma, West Pokot and Kajiado Counties</li> </ul>
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> <li>● West Pokot</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Limited perception on post-harvest losses by growers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Sensitization on the effect of post-harvest losses on enterprise profitability</li> </ul>

Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Involvement of stakeholders such as CBOs and NGOs enhances adoption</li> <li>● Continuous capacity building is key to attitude change. Consistent trainings, demonstrations and sensitizations</li> <li>● Motivate farmers to adopt the technology</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Policies targeting the empowerment of women and youth as entrepreneurs in society.</li> <li>● Construction of onion storage areas in retail markets</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Increased yields due to reduced harvesting losses
Gender issues and concerns in Development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths in transportation.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths and those recovering from drugs in transportation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni and Narok</li> </ul>
Application guidelines for users	Brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	<ul style="list-style-type: none"> <li>● KALRO</li> </ul> F. Wayua, V. Ochieng, L. Wasilwa, C. Gathambiri

Partner organizations	<ul style="list-style-type: none"> <li>● National and County Ministry of Agriculture, Livestock and Fisheries</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● HCDA</li> </ul>
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**Research GAPS:**

1. Validating maturity indices of the various Onion varieties / landraces
2. Quantification of the losses due to incorrect timing of the right maturity for harvesting different Onion varieties
3. Quantification of losses of manual vs. mechanical Onion harvesting, including the cost-benefit analyses of each method.

2.8.2.TIMP Name	Curing of onions
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Postharvest losses due to decay of harvested and stored onions
What is it? (TIMP description)	<p>Curing is the process of drying (naturally or artificially) the necks and outer scale leaves of the bulb to prevent loss of moisture and decay during storage, and to reduce chances of sprouting during storage.</p> <p><i>Natural curing</i> involves spreading of onions on a wire rack in a well-ventilated and shaded area, putting a covering on top for protection from rain. Curing can also be done by tying the tops of the bulbs in bunches and hanging them on a horizontal pole in a well-ventilated area. <i>Artificial curing</i> is done by blowing hot air at 30°C and 75-80% relative humidity over onions piled in trays or crates, for 12 hours.</p> <div style="text-align: center;"> </div> <p style="text-align: center;">Natural curing of onions</p>
Justification	Curing decreases, the incidence of postharvest diseases such as neck rot, reduces water loss and sprouting during storage, prevents microbial infection, and is desirable for development of good scale colour and increased shelf life
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>● Farmers, traders, exporters</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Establishment of collection centres and bulking points</li> <li>● Brochures, leaflets and manuals</li> <li>● Seminars to create awareness</li> <li>● ICT tools (WhatsApp, mobile apps)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Application of all GAPs in onion production (e.g. timely harvesting, correct harvesting, cleaning of the harvested onion before curing)</li> <li>● Creating awareness on effects of improper post-harvest handling</li> <li>● Adequate funding to train on the post-harvest technology</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion Extension service (public and private) – technology transfer and dissemination</li> <li>● Researchers (KALRO, universities) – establishment of demonstration plots, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> </ul>

	<ul style="list-style-type: none"> <li>• NGOs and CBOs (FCI, Twiga Foods) – farmer recruitment and mobilization, up-scaling of technologies</li> <li>• Traders – buying onions from farmers, dictating on onion quality (hence need for curing)</li> <li>• Financial institutions – avail funds to establish curing facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Nyeri., Kirinyaga, Bungoma, West Pokot, Kajiado
Counties where TIMPs will be upscaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Poor perception on the impact of curing on post-harvest losses</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Capacity building on curing technology</li> <li>• Sensitization of growers on the impact of curing on post-harvest losses</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>• Involvement of stakeholders such as CBOs and NGOs enhances adoption</li> <li>• Continuous and consistent capacity building is key to attitude change and adoption of the technology.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Policies targeting the empowerment of women and youth as entrepreneurs in society.</li> <li>• There is high demand for onions that are fully cured hence better market prices</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Increased income due to reduced storage losses and enhanced keeping quality
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge.</li> <li>• Women have less access to land that can be used for onion farming than men.</li> <li>• Women have limited access to education, training and extension services than men.</li> </ul>
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Opportunity exist for youths and women in curing.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Opportunity exist for youths and those recovering from drugs in curing.</li> </ul>
VMG issues and concerns in adoption and scaling up	After creating awareness the technology will gain a lot of interest for adoption
VMG related opportunities	The technology will create job hence source of income for

	VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	Brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Director Horticulture Research Institute P.O. Box 220-01000 Thika Email: director.hri@kalro.org
Lead organization and scientists	<ul style="list-style-type: none"> <li>KALRO-Kakamega</li> <li>F. Wayua, V. Ochieng, Wasilwa L.,</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>Ministry of Agriculture (County Governments)</li> <li>JKUAT</li> <li>Egerton University</li> <li>CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>Hotels, restaurants, food processing companies</li> <li>Exporters</li> <li>HCDA</li> </ul>



<b>2.8.3.TIMP Name</b>	Onion storage
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Postharvest losses of harvested onions
What is it? (TIMP description)	A well-ventilated clean and dry storage room for preserving onions. Controlled atmosphere storage is increasingly practiced to extend the marketing period.
Justification	Well preserved onions can stay up to six months without getting spoilt; although it is advisable to use or sell them as early as possible as they will slowly lose weight.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, exporters and consumers (households, institutions, restaurants, hotels and food processing industry)
Approaches used in dissemination	<ul style="list-style-type: none"> <li>On farm demonstration and training</li> <li>Seminars to create awareness</li> <li>Farmer exchange visits, study tours and market exposures</li> <li>Public-private partnerships (Establish and strengthen partnerships between commercial villages and private business sector)</li> </ul>

	<ul style="list-style-type: none"> <li>● Establishment of collection centres and bulking points</li> <li>● Business forums of buyers and sellers</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Application of GAPs in onion production (e.g. timely harvesting, correct harvesting, appropriate curing of the harvested onion before storage)</li> <li>● Creating awareness on effects of improper post-harvest handling</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion</li> <li>● Extension service (public and private) – technology transfer and dissemination</li> <li>● Researchers (KALRO, universities) – establishment of demonstration plots, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – farmer recruitment and mobilization, up-scaling of technologies</li> <li>● Traders and consumers – buying onions from farmers, dictating on onion quality (hence need for appropriate curing and storage)</li> <li>● Financial institutions – avail funds to establish curing facilities and onion stores</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Kieni, Kirinyaga, Bungoma, West Pokot, Kajiado and Kitengela
Counties where TIMPs will be up-scaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Lack of knowledge and awareness on storage of onions</li> <li>● Funding for initial capital to construct the stores</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Creating awareness and capacity building of value chain actors</li> <li>● Availing credit and financial facilities to farmers and traders to get capital to establish onion stores</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Proper post harvesting handling reduce loss up to 25%</li> <li>● Involvement of stakeholders such as CBOs and NGOs enhances adoption</li> <li>● Continuous capacity building is key to attitude change.</li> <li>● Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the technology</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● The technology is environment friendly as it will reduce effect from loss after harvesting</li> <li>● There is high demand for onions that are full cured hence better market prices</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Increased income due to reduced storage losses and enhanced keeping quality
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> </ul>

	<ul style="list-style-type: none"> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
	<ul style="list-style-type: none"> <li>●</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths and women in onion storing.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and up scaling	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	Opportunity exist for youths and those recovering from drugs in onion storing.
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	Brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires further research
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	KALRO  F. Wayua, V. Ochieng, L. Wasilwa, C. Gathambiri
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>

### Research GAPS

1. Proper storage procedures for long shelf-life
2. Shelf life of the white cultivars which tend to store poorly

<b>2.8.4.TIMP Name</b>	<p><b>Control of fungal and bacterial rots of onions:</b></p> <ul style="list-style-type: none"> <li>(i) Pre-harvest application of a registered fungicide such as Rovral</li> <li>(ii) Harvesting at proper maturity</li> <li>(iii) Minimising bruising of bulbs</li> <li>(iv) Discarding defective onions</li> </ul>
	<ul style="list-style-type: none"> <li>(v) Prompt and effective curing</li> <li>(vi) Storing as quickly as possible</li> </ul>
Category(i.e. technology, innovation or management practice)	Management practices
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Postharvest decay of harvested and stored onions
What is it? (TIMP description)	<p>A combination of management practices for controlling fungal and bacterial rots in onions:</p> <p>During the growing season, minimize damage to bulbs caused by insects and diseases. Avoid heavy or late applications of nitrogen fertilizer. Harvest onions when the crop is mature and necks are well-cured. Handle the crop with minimum bruising or wounding. Avoid late-season irrigation to allow the tissue to dry before harvest. The neck tissue must be well-cured before the crop is stored. Healthy onions that are properly stored are seldom affected. Store bulbs at temperatures of 5°C, or less, with low relative humidity and good circulation.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="display: flex; justify-content: space-around;"><b>Bacterial soft rot</b>      <b>Onion Botrytis Neck and Bulb Rot</b></p>
Justification	Fungal and bacterial rots are the main cause of postharvest losses of onions during transport and storage (estimated at 25%). The postharvest losses reduce farmers income.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, exporters and consumers (households, institutions, restaurants, hotels and food processing industry)
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures on post-harvest handling of onions</li> <li>● Seminars to create awareness</li> <li>● Farmer exchange visits and study tours</li> <li>● ICT (WhatsApp and mobile apps)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Application of GAPs in onion production (e.g. timely harvesting, correct harvesting, cleaning of the harvested onion before curing)</li> <li>● Creating awareness on effects of improper post-harvest handling</li> </ul>

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – establishment of demonstration plots, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – farmer recruitment and mobilization, up-scaling of technologies</li> <li>● Exporters and packhouse operators – buying onions from farmers; dictating on onion quality (hence need for appropriate curing and storage)</li> <li>● Consumers – buying onions from farmers and traders, hence need for appropriate curing and storage</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Kieni, Bungoma, West Pokot, Kajiado and Kitengela
Counties where TIMPs will be upscaled	Isiolo County (Kinna area), West Pokot, Kitengela, Narok, Taita Taveta
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Lack of knowledge and awareness on control of bacterial and fungal rots of onions</li> <li>● Funding for initial capital to construct the stores</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Creating awareness and capacity building on pre-harvest crop management and postharvest handling practices</li> <li>● Availing credit and financial facilities to farmers and traders to get capital to establish onion stores</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>● Proper post harvesting handling reduce loss up to 25%</li> <li>● Involvement of stakeholders such as CBOs and NGOs enhances adoption</li> <li>● Continuous capacity building is key to attitude change.</li> <li>● Consistent trainings, demonstrations and sensitisations would</li> </ul>
	motivate farmers to adopt the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● The technology is environment friendly as it will reduce effect from loss after harvesting</li> <li>● There is high demand for onions of superior grade</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced postharvest losses, hence increased sales, income and enhanced family nutrition
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths and women in onion storing.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> </ul>




	<ul style="list-style-type: none"> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths and those recovering from drugs in onion storing.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Brochures, factsheets and manuals</li> <li>● Bulletins, policy briefs</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
Lead organization and scientists	KALRO F. Wayua, V. Ochieng, L. Wasilwa, C. Gathambiri
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> </ul>
	<ul style="list-style-type: none"> <li>● Local Authorities</li> </ul>

<b>2.8.5.TIMP Name</b>	<b>Sorting and grading of onions</b>
Category (i.e. technology, Innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>● Poor quality due to mix-up of onions of different grades postharvest (mixing of good quality onions with damaged ones)</li> <li>● Spread of rot-causing microorganisms from good quality to poor quality onions</li> </ul>

What is it? (TIMP description)	<p><b>Sorting and grading</b></p> <ul style="list-style-type: none"> <li>● Trim the onion roots and leaves using a sharp knife, and cut 4-6 cm from the bulb.</li> <li>● Sort and discard onions that are bruised, damaged by pests, diseases, sun-scald and sprouted.</li> <li>● Onions bulbs are grading according to colour and size, as follows: <ul style="list-style-type: none"> <li>• Grade 1: Big sized onions</li> <li>• Grade 2: Small sized onions</li> <li>• Grade 3: Bulb-lets</li> </ul> </li> </ul>
Justification	<ul style="list-style-type: none"> <li>● Sorting removes damaged onions from good quality ones, hence reducing the spread of rot-causing microorganisms, hence extends the shelf-life.</li> <li>● Graded onions fetches better prices to the farmer and trader</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and buyers (households, institutions, hotels, restaurants, food processing companies, hotels)
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and capacity building of farmers and value chain actors</li> <li>● Brochures on post-harvest handling of onions</li> <li>● Seminars to create awareness</li> </ul>
Critical/essential factors for successful promotion	Favourable policy whereby premium grade is paid higher price
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – establishment of demonstration plots, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – farmer recruitment and mobilization, up-scaling of technologies</li> <li>● Exporters and packhouse operators – buying onions from farmers; dictating on onion quality (hence need for appropriate curing and storage)</li> <li>● Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement</li> <li>● Consumers – buying onions from farmers and traders, hence need for appropriate curing and storage</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nyeri, Bungoma, West Pokot
Counties where TIMPs will be upscaled	West Pokot
Challenges in development and dissemination	Currently, onion payments are based on quantity and not quality. Hence no incentives by value chain actors to adopt quality-based systems such as sorting and grading
Suggestions for addressing the challenges	Adopting a quality-based system, where quality onions are priced Higher

Lessons learned in up scaling, if any	Proper postharvest handling reduce loss up to 25%
Social, environmental, policy and market conditions necessary for development and up-scaling	Policies targeting the empowerment of women and youth as entrepreneurs in society.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better quality, and increased income and nutrition
Gender issues and concerns in development and dissemination, adoption and up scaling	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youths and women in the activity.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths in the activity.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Brochures, factsheets and manuals</li> <li>● Bulletins, policy briefs</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires Validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	KALRO
Lead organization and scientists	<ul style="list-style-type: none"> <li>● KALRO-Muguga, Perkerra, Kibos (Horticulture), Kakamega</li> <li>● V. Ochieng, Paul Omolo, F. Wayua, Wasilwa L.,</li> </ul>



Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>
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2.8.6.TIMP Name		Packaging of onions (net bags or crates)	
Category (i.e. technology, innovation or management practice)	Technology		
<b>A: Description of the technology, innovation or management practice</b>			
Problem to be addressed	Postharvest losses (estimated at 25%) due to inappropriate packaging of onions		
What is it? (TIMP description)	<ul style="list-style-type: none"> <li>● This is a net bags or crates used for packaging onions; they allow air movement through the onions. Crates are preferred to nets since they offer more protection to the onion.</li> <li>● Locally the domestic wholesale and retail market net bag is 13 kg. For packaging of onions, the bag is 460 mm and 850 mm can contain up to 32 kg.</li> </ul> <div style="display: flex; justify-content: space-around; align-items: center;">    </div>		
Justification	Packaging provides protection of produce from mechanical damage and poor environmental conditions during handling, transportation and distribution thus <ol style="list-style-type: none"> <li>(a) Reducing postharvest losses and extending the postharvest and marketable life of produce.</li> <li>(b) Offering a competitive advantage through aesthetic presentation of the product to the consumer making it more desirable</li> </ol>		
<b>B: Assessment of dissemination and scaling up/out approaches</b>			
Users of TIMP	Farmers, traders, exporters and consumers (households, institutions, restaurants, hotels and food processing industry)		

Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures on post-harvest handling of onions</li> <li>● Seminars to create awareness</li> <li>● Farmer exchange visits and study tours</li> <li>● Capacity building – Common Interest Groups (CIG)</li> <li>● Establishment of collection centres</li> <li>● ICT (WhatsApp and mobile apps)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● The package should allow air movement through the onions</li> <li>● Creating awareness on effects of improper post-harvest handling</li> <li>● Onions should be transported and stored separately from other kinds of produce. Many types of fruits and vegetables will readily absorb the odor of onions. Well -dried onions also draw moisture readily from fresh vegetables.</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers – for activity implementation and promotion</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – establishment of demonstration plots, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – farmer recruitment and mobilization, up-scaling of technologies</li> <li>● Exporters and packhouse operators – buying onions from farmers; dictating on onion quality (hence need for appropriate curing and storage)</li> <li>● Government regulatory agencies (e.g. KEBS) – quality standards formulations and enforcement</li> <li>● Consumers – buying onions from farmers and traders, hence need for appropriate curing and storage</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Kieni, Bungoma, West Pokot, Kajiado and Kitengela
Counties where TIMPs will be upscaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Funding for initial capital to construct the stores</li> <li>● Lack of knowledge and awareness on the post-harvest technology</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Creating awareness on the technology</li> <li>● Availing of funds</li> </ul>
Lessons learned in up scaling, if any	Proper postharvest handling reduce loss up to 25%
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Availability of biodegradable plastic nets</li> <li>● Affordable collapsible plastic crates</li> <li>● Carpenters trained to produce appropriate wooden crates that are reusable</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Increased shelf life, hence more marketable produce.

Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge</li> <li>● Women have less access to land that can be used for onion farming than men</li> <li>● Women and youth have limited access to education, training and extension services than men</li> <li>● Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunity exist for and women in sorting</li> </ul>
VMG issues and concerns in development and dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge</li> <li>● VMGs have limited access to land.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for elderly and those who are disabled in sorting.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</p> <ul style="list-style-type: none"> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Brochures, factsheets and manuals</li> <li>● Bulletins, policy briefs</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	<p>The Institute Director Horticulture Research Institute P.O. Box 220-01000, Thika Email: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a></p>
Lead organization and scientists	<p>KALRO</p> <ul style="list-style-type: none"> <li>● F. Wayua, V. Ochieng, L. Wasilwa, C. Gathambiri</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>

## 2.9 Value Addition of Onions

<b>2.9.1.TIMP Name</b>		<b>Dehydrated onions</b>
Category (i.e. technology, innovation or management practice)	Technology	
<b>A: Description of the technology, innovation or management practice</b>		
Problem to be addressed	Extreme seasonal volatility in onion prices; limited utilization of onions	
What is it? (TIMP description)	<p>Dried onion flakes prepared by drying onion slices. Onion powder is prepared by grinding the dry onion slices.</p>  <p style="text-align: center;">Dehydrated onion flakes and powder</p> <p>Dehydration can be carried out using various types solar dryers. E.g. Solar tunnel dryers, chimney dryers etc.</p>	
	 <p style="text-align: center;">Solar dryers for onions      Solar dryers for onions</p> <p>Dried onion is marketed in the form of slices, granules and powder. The dehydrated onion are packed in clean and sound</p>	
Justification	Dehydration of onion reduces packing costs, eliminates refrigeration requirements, lowers transportation and storage costs, and provides food of greater economic value. Dehydrated onions are important in international trade. Onion powder is used as a constituent in various food products, i.e. as an industrial raw material to food processing factories, hotels, restaurants, caterers and domestic consumption. Onion powder has also good export market.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Farmers, traders, industrial and commercial processors, exporters and consumers (households, institutions, restaurants, hotels and food processing industry)	
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures on post-harvest handling of onions</li> <li>● Seminars to create awareness</li> <li>● Farmer exchange visits and study tours</li> <li>● Capacity building – Common Interest Groups (CIG)</li> </ul>	
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Increased production of fresh onions</li> <li>● Establishment of aggregation centers</li> <li>● Availability of drying facilities</li> </ul>	


	<ul style="list-style-type: none"> <li>● Availability of suitable packaging for dehydrated onions</li> <li>● Ready market for dehydrated onions in the hospitality industry thus increase</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers and farmer groups – for activity implementation and promotion (production of fresh onions, managing the drying facilities, establishment of demonstration centres hosting the drying facilities)</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – support the development of quality and safe dehydrated onion products, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – purchase of dehydrated onions, dictating on right packaging of onions</li> <li>● Private sector processors</li> <li>● Supermarkets and institutions (e.g. schools and hospitals) will provide market for dehydrated onions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Kieni, Bungoma, West Pokot, Kajiado and Kitengela
Counties where TIMPs will be upscaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Funding for initial capital to construct the drying facilities</li> <li>● Lack of capacity of farmers and farmer groups to produce quality and safe product</li> <li>● Lack of knowledge and awareness in maintaining quality of dehydrated products</li> <li>● Availability of local market for dehydrated onions</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Funding the establishment of aggregation centres with dehydration facilities</li> <li>● Creating awareness in the local market on dehydrated onions</li> <li>● Building capacity of the farmers and farmer groups to produce quality and safe products.</li> </ul>
Lessons learned in up scaling, if any	Proper postharvest handling reduce loss up to 25%
Social, environmental, policy and market conditions necessary for development and up-scaling	Policies targeting the empowerment of women and youth as entrepreneurs in society.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not determined
Estimated returns	Not determined
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths in packaging.</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for youths in Packaging.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP / KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	Dehydrated onions brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires Validation; 3. Requires further research)	1. Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kakamega; P. O. Box 169-50100, Kakamega. Email: <a href="mailto:francis.wayua@gmail.com">francis.wayua@gmail.com</a> , Tel. 0710629683
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT – Willis Owino</li> <li>● KALRO-Muguga, Kibos (Horticulture), Kakamega</li> <li>● Francis Wayua, V. Ochieng, Paul Omolo, Wasilwa L.,</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>

### Research GAPS

- Identifying specific onion varieties that are suitable for specific drying systems and those that retain optimal levels of bioactive compounds and nutritional value Optimizing the drying characteristics under specific drying systems under specific agroecological zones.
- Develop high quality and safe dehydrated products.

<b>2.9.2.TIMP Name</b>	<b>Pickling of onions</b>
Category (i.e. technology, innovation or management practice)	Innovation

<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Extreme seasonal volatility in onion prices, food spoilage and reduced shelf life of fresh onions
What is it? (TIMP description)	<p><b>Pickling</b> is the process of preserving or extending the lifespan of onions by either anaerobic fermentation (<i>Lactobacillus</i> bacteria) in brine or immersion in specific edible chemical solutions such as brine (high in salt), vinegar, alcohol, and vegetable oil,</p> <p>Pickling imparts unique characteristics to onions. Desirable changes in flavor, texture, and color take place in pickled products. However, some of the same bacteria involved in normal fermentation, such as the lactic-acid-formers, may cause spoilage if not destroyed. Pickled foods appear as both condiments, seasonings and integral ingredients in a number of prepared dishes</p>  <p><i>Pickled onions (Source: Willis Owino, JKUAT)</i></p>
Justification	<p>Pickling is a form of food preservation that prevents spoilage and greatly extends shelf life of the product. It is a more economical form of preservation since the product is stable at room temperature.</p> <p>Many fermented foods are good sources of nutrients, including vitamins, amino acids and healthy bacteria. The sodium content in large quantities of pickle juice could facilitate hydration and potentially reduce muscle cramps after excessive sweating. Despite potential benefits, high-sodium products are consumed only in moderation.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and farmer groups, traders, exporters, food processors and consumers (households, institutions, restaurants, hotels and food processing industry)
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures on pickling of onions</li> <li>● Seminars to create awareness</li> <li>● Farmer exchange visits and study tours</li> <li>● Capacity building – Common Interest Groups (CIG)</li> <li>● Establishment of collection centres</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Increased production of fresh onions</li> <li>● Establishment of aggregation centers</li> <li>● Availability of pickling facilities</li> <li>● Availability of suitable packaging for dehydrated onions</li> </ul>

	<ul style="list-style-type: none"> <li>Expansion of food and hotel industry thus increase in onion demand</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>Farmers and farmer groups – production of fresh onions, managing the pickling facilities, establishment of demonstration centres hosting the pickling facilities</li> <li>Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>Researchers (KALRO, universities) – support the development of quality and safe pickled onion products, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>NGOs and CBOs (FCI, Twiga Foods) – assist in up-scaling of technologies</li> <li>Traders, exporters and packhouse operators – purchase of pickled onions, dictating of quality parameters</li> <li>Consumers (households, supermarkets, hotels, institutions, restaurants, food processing industry) – buying of pickled onions, dictate on packaging for the products</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Onion growing regions in Kieni, Bungoma, West Pokot, Kajiado and Kitengela
Counties where TIMPs will be up scaled	Isiolo County (Kinna area), West Pokot, Kitengela, Narok, Taita Taveta
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>Funding for initial capital to construct the facilities</li> <li>Lack of capacity of farmers and farmer groups to produce quality and safe product</li> <li>Lack of knowledge and awareness in maintaining quality of pickled products</li> <li>Availability of local market for pickled onions</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>Funding the establishment of aggregation centres with facilities</li> <li>Creating awareness in the local market on pickled onions</li> <li>Building capacity of the farmers and farmer groups to produce quality and safe products</li> </ul>
Lessons learned in up scaling, if any	Proper postharvest handling reduce loss up to 25%
Social, environmental, policy and market conditions necessary for development and up-scaling	Policies targeting the empowerment of women and youth as entrepreneurs in society.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Dehydration equipment and facilities
Estimated returns	Increased sales and hence income
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Women have less access to information, technology and knowledge</li> <li>Women have less access to land that can be used for onion farming than men</li> <li>Women and youth have limited access to education, training and extension services than men</li> <li>Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Women and youth stand to benefit in production, use and sale of dehydrated onions</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge</li> <li>● VMGs have limited access to land.</li> <li>● VMGs have limited access to training and extension services</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>● There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity to produce, trade in, and consume dehydrated onions</li> <li>● Dehydrated onions can be used to make various diversified products for consumption by the VMGs, hence contributing to their nutrition.</li> <li>● Women can diversify family diets and generate income at village level by making the products for sale.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>● Farmer empowerment: Farmers in Ortum in West Pokot (KAPP /KAPAP project). The bulb onion farmers no longer rely on relief food</li> <li>● Success stories of individual farmers in Naromoru, Kieni, Narok and Mt. Elgon</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>● Brochures, factsheets and manuals</li> <li>● Bulletins, policy briefs</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Requires further research
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kakamega; P. O. Box 169-50100, Kakamega. Email: <a href="mailto:francis.wayua@gmail.com">francis.wayua@gmail.com</a> , Tel. 0710629683
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT – Willis Owino</li> <li>● KALRO-Muguga, Kibos (Horticulture), Kakamega</li> <li>● Francis Wayua, V. Ochieng, Paul Omolo, Wasilwa L.,</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>

### Research GAPS

1. Identifying specific onion varieties that are suitable for pickling in terms of quality
2. Optimizing the pickling process and developing quality and safe pickles

<b>2.9.3.TIMP Name</b>	<b>Essential oils from onions</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	

Problem to be addressed	Extreme seasonal volatility in onion prices, limited utilization of onions, food spoilage and reduced shelf life of fresh onions
What is it? (TIMP description)	<p>Essential oil extracted from onions through distillation process. The essential oil can be used for pharmaceutical, chemical and food applications (soups, meat, table sauces, salad dressings, and savories) The bioactive properties and characteristic flavor of onion have been attributed to its sulfur compounds, which are present in the volatile fraction (known as onion oil).</p> <p>One method of production of onion oil is steam distillation of crushed onion bulbs. The water-insoluble extractive obtained is a dark-yellow or brownish-yellow liquid with an intense flavor. It consists of a complex mixture of volatile sulfur compounds, mostly mono-, di-, tri-, and tetra-sulphides with different alkyl groups. Generally, 1 g of onion oil is equivalent to the flavor of 4.4 kg of fresh onions or 500 g onion powder. After extraction, the onion oil is stabilized using carriers (e.g. carbohydrates, soluble fibres or other edible material) to get dry, soluble or fat-based soluble spices.</p>
Justification	The odor and flavor properties of onion oil and its components have been used extensively to impart flavors to processed food (soups, meat, table sauces, salad dressings, and savories) without the difficulties of handling a large bulk of fresh bulbs. In addition to its flavoring properties, it has been demonstrated that onion oil has antioxidant, anti-browning, and antimicrobial properties that could enhance the quality and safety of processed foods (e.g. fresh cut potato, fresh cut fruits and vegetables, fresh meat cuts etc.), while being a natural additive that consumers prefer (and hence, the food industry has to provide).
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and farmer groups, hospitality industry, households, institutions, food processing industry, traders and exporters
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On site demonstration and training</li> <li>● Brochures on post-harvest handling of onions</li> <li>● Seminars to create awareness</li> <li>● Capacity building – Common Interest Groups (CIG)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Increased production of fresh onions</li> <li>● Establishment of aggregation centers.</li> <li>● Availability of processing facilities</li> <li>● Ready market for onions oil in the hospitality industry, food industry and pharmaceutical industry</li> </ul>


Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers and farmer groups – production of fresh onions, managing the processing facilities, establishment of demonstration centres hosting the processing facilities</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – support the development of quality and safe essential onion oil, conduct on-farm research, capacity building of county stakeholders, extension workers and farmers</li> <li>● NGOs and CBOs (FCI, Twiga Foods) – assist in up-scaling of technologies</li> <li>● Traders, exporters and packhouse operators – purchase of the onion oil, dictating of quality parameters</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	<ul style="list-style-type: none"> <li>● Onion growing regions in Kieni, Bungoma, West Pokot, Kajiado and Kitengela</li> </ul>
Counties where TIMPs will be upscaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Funding for initial capital to construct the processing facilities</li> <li>● Lack of capacity of farmers and farmer groups to produce quality and safe product</li> <li>● Lack of knowledge and awareness in production of onion oil</li> <li>● Availability of local market for the onion oil</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Funding the establishment of aggregation centres with processing facilities</li> <li>● Creating awareness in the local market on the value of onion oil</li> <li>● Building capacity of the farmers and farmer groups to produce quality and safe products.</li> </ul>
Lessons learned in up scaling, if any	Value addition can minimize postharvest losses up to 25%
Social, environmental, policy and market conditions necessary for development and up-scaling	Policies targeting the empowerment of women and youth as entrepreneurs in society.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Essential oil processing facilities
Estimated returns	Increased sales and hence income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunity for women to produce, trade in and consume pickled onions.</li> <li>● Women can diversify family diets and generate income at village level by making the products for sale.</li> </ul>
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> </ul>

adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs have limited access to productive resources such as land, credit and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunity exist for VMGs to produce, trade in, and consume pickled onions</li> <li>● Pickled onions can be used to make various diversified products for consumption by the VMGs, hence contributing to their nutrition.</li> <li>● Women can diversify family diets and generate income at village level by making the products for sale</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	Onion essential oil production, brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires Validation; 3. Requires further research)	3. Requires further research
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kakamega; P. O. Box 169-50100, Kakamega. Email: <a href="mailto:francis.wayua@gmail.com">francis.wayua@gmail.com</a> , Tel. 0710629683
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT – Willis Owino</li> <li>● KALRO-Muguga, Kibos (Horticulture), Kakamega</li> <li>● Francis Wayua, V. Ochieng, Paul Omolo, Wasilwa L.,</li> </ul>
Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>

### Research GAPS

1. Identifying specific onion varieties that are suitable for oil extraction. Optimizing the onion oil extraction methods to obtain oil with high quality preserving characteristics
2. Develop high quality and safe stable onion oil spices

<b>2.9.4.TIMP Name</b>	<b>Onion wine</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	

Problem to be addressed	Limited utilization of onions
What is it? (TIMP description)	Wine made from onions 
Justification	Diversification of onions food products will enhance consumption of onions, enhance demand and thus lead to increased production and utilization of onion. Promotion of value added products will enhance adoption and production
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and farmer groups, wine processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● On farm demonstration and training</li> <li>● Brochures on pickling of onions</li> <li>● Seminars to create awareness</li> <li>● Farmer exchange visits and study tours</li> <li>● Capacity building – Common Interest Groups (CIG)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Increased production of fresh onions</li> <li>● Establishment of aggregation centers</li> <li>● Availability of wine making facilities</li> <li>● Existence of effective extension services to demonstrate the technology</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>● Farmers and farmer groups – production of fresh onions, managing the pickling facilities, establishment of demonstration centres hosting the pickling facilities</li> <li>● Extension service (public and private) – technology transfer and dissemination, policy formulation and enforcement</li> <li>● Researchers (KALRO, universities) – capacity building on onion wine</li> </ul>
	<ul style="list-style-type: none"> <li>● Traders, exporters and packhouse operators – purchase of pickled onions, dictating of quality parameters</li> <li>● Consumers (households, supermarkets, hotels, institutions, restaurants, food processing industry) – buying of pickled onions, dictate on packaging for the products</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>● Funding for initial capital to construct the facilities</li> <li>● Lack of capacity of farmers and farmer groups to produce onion wine</li> <li>● Availability of local market for onion wine</li> </ul>


Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Funding the establishment of aggregation centres with facilities</li> <li>● Creating awareness in the local market on onion wine</li> <li>● Building capacity of the farmers and farmer groups on onion wine making</li> </ul>
Lessons learned in up scaling, if any	-
Social, environmental, policy and market conditions necessary for development and up-scaling	Policies targeting the empowerment of women and youth as entrepreneurs in society.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Wine making equipment and facilities
Estimated returns	Increased sales and hence income
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women have less access to information, technology and knowledge.</li> <li>● Women have less access to land that can be used for onion farming than men.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Men dominant most decisions at the household and community levels.</li> </ul>
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>● Women and youth stand to benefit from this technology through job creation.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● VMGs have less access to agricultural information, technology and knowledge.</li> <li>● VMGs have limited access to productive resources such as land, credit, and quality seed.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	Women and youth stand to benefit in the technology through job creation.
<b>E: Case studies/profiles of success stories</b>	
Success stories	Experiences from other countries
Application guidelines for users	Brochures, factsheets and manuals
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	4. Requires further research
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kakamega; P. O. Box 169-50100, Kakamega. Email: <a href="mailto:francis.wayua@gmail.com">francis.wayua@gmail.com</a> , Tel. 0710629683
Lead organization and scientists	<ul style="list-style-type: none"> <li>● JKUAT – Willis Owino</li> <li>● KALRO-Muguga, Kibos (Horticulture), Kakamega</li> <li>● Francis Wayua, V. Ochieng, Paul Omolo, Wasilwa L.,</li> </ul>

Partner organizations	<ul style="list-style-type: none"> <li>● Ministry of Agriculture (County Governments)</li> <li>● JKUAT</li> <li>● Egerton University</li> <li>● CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)</li> <li>● Hotels, restaurants, food processing companies</li> <li>● Exporters</li> <li>● HCDA</li> <li>● Finance Institutions</li> <li>● Local Authorities</li> </ul>
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## Research GAPS

1. Identification of the specific onion varieties for wine processing

### 2.10 Onion Mechanization

TIMP Name		4 Wheeled Tractor 50Hp	
Category (i.e. technology, innovation or management practice)	Technology		
<b>A: Description of the technology, innovation or management practice</b>			
Problem to be addressed	<ul style="list-style-type: none"> <li>● Difficult to prepare a uniform fine tilth seedbed manually</li> <li>● Delayed operation lead to late planting</li> <li>● Slow and tedious processes of seedbed preparation, in a commercialized Onion commodity</li> <li>● High cost of manual labour</li> </ul>		
What is it? (TIMP description)	<p>A small sized, 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, chisel or water pump at alternate times for easing farm operations. It can do 4 hectares per day by one operator but can have two operators to run another 8 hours of 4 hectares coming to 8ha 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.</p>		
Justification	<p>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 threshing through a power take off device and transporting produce. Farm sizes less than one hectare may limit maneuverability of conventional tractors yet manual Labour is costly and slow.</p>		
<b>B: Assessment of dissemination and scaling up/out approaches</b>			
Users of TIMP	Onion farmers and researchers		
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools (FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> </ul>		


	<ul style="list-style-type: none"> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive Research to evaluate and recommend the tractor for small scale farmers.</li> <li>● A platform for interaction of onion value chain stakeholders</li> <li>● Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)  Machinery dealers  NGO supporting farmers for dissemination</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Baringo, Machakos
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Lack of tractors</li> <li>● Lack of facilitation to demonstration site</li> <li>● High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish a 4-wheeled innovation platform</li> <li>● Acquisition of the machines</li> <li>● Lack of facilitation to demonstration site</li> <li>● Build financial capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful up-scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption</li> <li>● Mechanization in agriculture increases production</li> <li>● Mechanization releases labour to alternative requirement areas</li> <li>● Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in agricultural production</li> <li>● Include all gender groups in research, and validation.</li> <li>● Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women perform most of the crop production activities therefore the implement will reduce their drudgery of work.</li> <li>● Women and youth have limited access credit to purchase the power tiller.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and males in operating the implement.</li> </ul>

	<ul style="list-style-type: none"> <li>● Introduction of this labor intensive implement will reduce women's work burden.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● VMGs have limited access to credit to purchase the farm implements.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities exist for unemployed youth in operating the implement.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>

#### **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"> <li>● Demonstrations and training</li> <li>● User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for up scaling; 2-requires validation; 3-requires further research)	Ready for up scaling Ready for out scaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

<b>TIMP Name</b>	<b>Mouldboard Plough</b>
Category (i.e. technology, innovation or management practice)	Technology

	
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>● Slow and tedious processes of seedbed preparation, in a commercialized onion commodity</li> <li>● Difficult to prepare a uniform fine tilth seedbed manually</li> <li>● Delayed operation lead to late planting</li> <li>● High cost of manual Labour</li> </ul>
What is it? (TIMP description)	Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation.
Justification	Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is Versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Potato farmers and researchers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools(FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive Research to test, validate and release improved onion varieties</li> <li>● A platform for interaction of onion value chain stakeholders</li> <li>● Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Baringo, Machakos
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Lack of machines</li> <li>● Lack of facilitation to demonstration site</li> </ul>


	<ul style="list-style-type: none"> <li>● High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish Onion innovation platforms</li> <li>● Acquisition of the machines</li> <li>● Lack of facilitation to demonstration site</li> <li>● Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>● Mechanization in agriculture increases production</li> <li>● Mechanization releases labour to alternative requirement areas</li> <li>● Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in agricultural production</li> <li>● Include all gender groups in research, and validation.</li> <li>● Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women perform most of the crop production activities therefore the implement will reduce their drudgery of work.</li> <li>● Women and youth have limited access credit to purchase the mouldboard Plough.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and males in operating the implement.</li> <li>● Introduction of this labor intensive implement will reduce women's work burden.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● VMGs have limited access to credit to purchase the farm implements.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness.</li> </ul>

VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities exist for unemployed youth in operating the implement.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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"> <li>● Demonstrations and training</li> <li>● User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for up scaling; 2-requires validation; 3-requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	Nasirembe W, KALRO, Egerton University, Pole F.N.
Partner organizations	Local Fabricators

TIMP NAME	Raised bed maker
Category (i.e. technology, innovation or management practice)	Technology 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>● Slow and tedious processes of raised seedbed preparation, in a commercialized onion commodity</li> <li>● It's harder to prepare a uniform fine tilth raised seedbed manually</li> <li>● Delayed operation lead to late planting</li> <li>● Low acreage because of lack of manual labour</li> <li>● High cost of manual labour</li> </ul>
What is it? (TIMP description)	It is an implement consisting of a heavy frame set with spikes on a PTO driven shaft or tines which is dragged over ploughed land to break up clods, remove weeds, cover weed seed too deep for germination and is a cultivating tool set used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.
Justification	<ul style="list-style-type: none"> <li>● Creating of a crumbly layer for planting is tedious.</li> </ul>


	<ul style="list-style-type: none"> <li>● It is not possible to manually protect the soil surface from rapid drying.</li> <li>● Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken.</li> <li>● Manual operation will reduce microbiological processes in the soil</li> <li>● Manual land harrowing Improves nutrient availability to plants.</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion farmers and researchers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools (FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive Research to test, validate and release improved onion varieties</li> <li>● A platform for interaction of onion value chain stakeholders</li> <li>● Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Makueni, Kitui, Baringo
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Lack of machines</li> <li>● Lack of facilitation to demonstration site</li> <li>● High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish Onion innovation platforms</li> <li>● Acquisition of the machines</li> <li>● Lack of facilitation to demonstration site</li> <li>● Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>● Mechanization in agriculture increases production</li> <li>● Mechanization releases labour to alternative requirement areas</li> <li>● Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in agricultural production</li> <li>● Include all gender groups in research, and validation.</li> <li>● Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Women perform most of the crop production activities therefore the implement will reduce their drudgery of work.</li> </ul>

	<ul style="list-style-type: none"> <li>• Women and youth have limited access credit to purchase the raised bed maker.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in operating the implement.</li> <li>• Introduction of this labor intensive implement will reduce women's work burden.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>• VMGs have limited access to credit to purchase the farm implements.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for up scaling;, 2- requires validation; 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

TIMP Name		Small grain planter	
Category (technology, innovation or management practice)	Technology		
<b>A: Description of the technology, innovation or management practice</b>			
Problem to be addressed	<ul style="list-style-type: none"> <li>● Slow and tedious processes of planting, in a commercialized onion commodity</li> <li>● Difficult to deliver small grains in a row at specified seed rate manually</li> <li>● Delayed operation lead to late planting</li> <li>● Low acreage because of lack of manual Labour</li> <li>● High cost of manual Labour</li> </ul>		
What is it? (TIMP description)	<p>It is an implement consisting of a heavy frame set with separated hopper for fertilizer and seed. It is wheel driven to rotate the seed and fertilizer dispenser sprockets. Calibration of seed and fertilizer is done separately by interchanging pairs of gears to match the required gear ratio. It has coulters to open a furrow for delivery of seed and fertilizer while another is cover the planted furrow. The planter is dragged on a raised bed to plant.</p>		
Justification	<ul style="list-style-type: none"> <li>● Making rows and planting small seed at a specified rate as it is covered is not possible manually.</li> <li>● It is not possible to manually protect the soil surface from rapid drying.</li> <li>● It is even more difficult to plant small seed at a predetermine depth.</li> <li>● Manual operation will reduce microbiological processes in the soil</li> <li>● Mechanical onion seed planting increases germination uniformity</li> </ul>		
<b>B: Assessment of dissemination and scaling up/out approaches</b>			
Users of TIMP	Onion farmers and researchers		
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools (FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>		
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive research to evaluate and recommend</li> <li>● A platform for interaction of onion value chain stakeholders</li> <li>● Multiple usage, timeliness, efficiency and low cost</li> </ul>		
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination		
<b>C: Current situation and future scaling up</b>			
Counties where already promoted if any	Kilifi, Kwale, Lamu		
Counties where TIMP will be up scaled	Machakos		



Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Lack knowledge for appropriate machines</li> <li>● High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish Onion innovation platforms</li> <li>● Acquisition of the machines</li> <li>● Lack of facilitation to demonstration site</li> <li>● Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>● Mechanization in agriculture increases production</li> <li>● Mechanization releases labour to alternative requirement areas</li> <li>● Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in agricultural production</li> <li>● Include all gender groups in research, and validation.</li> <li>● Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 40,000 (power auger digger), KES 80,000 (Tractor mounted hole digger)
Estimated returns	KES 20,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Women perform most of the transplanting activities therefore the implement will reduce their drudgery of work.</li> <li>● Women and youth have limited access credit to purchase the small grain planter.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and males in operating the implement.</li> <li>● Introduction of this labor intensive implement will reduce women's work burden.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>● VMGs have limited access to credit to purchase the farm implements.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> </ul>

	<ul style="list-style-type: none"> <li>There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for unemployed youth in operating the implement.</li> <li>Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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"> <li>User manuals and leaflets</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

<b>3.10.7 TIMP Name</b>	<b>Motorised Sprayer</b>																																																																														
Category (technology, innovation or management practice)	Technology																																																																														
	 <table border="1"> <thead> <tr> <th colspan="6">Nozzle Guide for Band and Directed Spraying</th> </tr> <tr> <th></th> <th>Even Flat Fan</th> <th>Twin Even Flat Fan</th> <th>Hollow Cone</th> <th>Full Cone</th> <th>Disc and Core Cone</th> </tr> </thead> <tbody> <tr> <td><b>Herbicides</b></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>Good</td> <td></td> <td></td> <td></td> </tr> <tr> <td><b>Fungicides</b></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><b>Insecticides</b></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><b>Growth Regulators</b></td> <td>Good</td> <td></td> <td></td> <td>Very Good</td> <td></td> </tr> </tbody> </table>	Nozzle Guide for Band and Directed Spraying							Even Flat Fan	Twin Even Flat Fan	Hollow Cone	Full Cone	Disc and Core Cone	<b>Herbicides</b>						Pre-emerge	Very Good	Good		Good		Post-emerge Contact	Good	Very Good	Very Good			Post-emerge Systemic	Very Good	Good				<b>Fungicides</b>						Contact	Good		Good		Very Good	Systemic	Very Good				Good	<b>Insecticides</b>						Contact		Very Good	Very Good		Very Good	Systemic	Very Good				Good	<b>Growth Regulators</b>	Good			Very Good	
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<b>A: Description of the technology, innovation or management practice</b>																																																																															
Problem to be addressed	It is a slow and tedious processes of manual spraying onion; Onion has a high number of pests that invade leaf, stem tuber,																																																																														
What is it? (TIMP description)	A motorized <b>sprayer</b> is a device used to spray a liquid, where sprayers are commonly used for projection of the chemical, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers are man-portable units typically backpacks with spray guns. They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of																																																																														

	insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron including as well as foliar fertilizers.
Justification	<p>Pest reduce yields up to 98% and are a major menace in agricultural production. Before onion forms a canopy, broad leafed weeds compete with onion seedling for nutrients and light greatly reducing their yield. Manual sprayers are labour intensive while spraying labour is too expensive. It has lower pressure reducing its efficiency hence a motorized knapsack comes in handy.</p> <p>A modern motorized knapsack power that pumps four times faster and covers a wide area in a short time than the manual sprayer</p> <p>With the motorized sprayer, farmers can spray up to four acres of land in one day as compared to the manual one which covers two one in a day. It is also used for spraying cows and sheep to control tick infestation.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools (FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive research to test, validate and release improved onion varieties</li> <li>● A platform for interaction of onion value chain stakeholders</li> <li>● Use by Farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers (AGGRA)
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kilifi, Kwale, Taita Taveta, Lamu
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Relatively high cost for individual small-scale farmer.</li> <li>● Limited awareness of the existence of machine among some farmers.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish Onion innovation platforms</li> <li>● Encourage group/cooperative ownership</li> <li>● Launch and awareness campaign through demonstrations and trainings</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>● Products from local/indigenous crops attract huge market, yet very little is being done to promote growth</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>● Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
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"> <li>● Men perform most of the spraying activities therefore the implement will reduce their drudgery of work.</li> <li>● Women and youth have limited access credit to purchase the motorized sprayer.</li> <li>● Women and youth have limited access to education, training and extension services than men.</li> <li>● Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Employment opportunities exist for youth males and males in operating the implement.</li> <li>● Introduction of this labor intensive implement will reduce men’s work burden.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Introduction of the labor intensive implement will reduce the labor burden of</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● VMGs such as the elderly and those abled differently.</li> <li>● VMGs have limited access to credit to purchase the farm implements.</li> <li>● VMGs have limited access to training and extension services.</li> <li>● Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>● There is low adoption by VMGs due lack of awareness</li> </ul>
	<ul style="list-style-type: none"> <li>● Opportunities exist for unemployed youth males in operating the implement.</li> <li>● Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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"> <li>● User manuals and leaflets</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and	KALRO, Egerton University

scientists	Nasirembe W,
Partner organizations and contacts	Local Fabricators
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
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	
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Facilitation to access information</li> <li>● Affordability and easy to maintain machines</li> </ul>
VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
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	
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators
<b>TIMP Name</b>	
<b>Onion Machine harvesting</b>	
Category (technology, innovation or management practice)	Technology <div style="display: flex; justify-content: space-around; align-items: center;">   </div>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>● Manual harvesting is slower, tedious and untimely</li> <li>● Manual labour is diminishing escalating its cost</li> <li>● Manual harvesting includes low capacity and variable performance due to fatigue.</li> <li>● Low capacity causes manual harvest costs to be from 30 to 60% of total production costs.</li> </ul>
What is it? (TIMP description)	Onion harvest machine is designed for onion and tubers excavation. It can complete the working procedures of excavating, earth clearing and tubers laying on field surface.

Justification	<ul style="list-style-type: none"> <li>● It can harvest single ridge and single row, also single ridge and two rows, which greatly reduces the manpower demand and the harvesting operation cost.</li> <li>● Machine has the advantages of high-working efficiency and simple structure.</li> <li>● The greatest benefits of mechanical harvesting are their low operating cost and high efficiency, which make them economically beneficial for large operations despite the considerable initial expense.</li> <li>● Discourages child labour</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Onion Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>● Farmer field and business Schools (FFBS)</li> <li>● Agricultural Innovation Platforms (AIP)</li> <li>● Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Applied and adaptive Research to test, validate and release improved onion varieties</li> <li>● A platform for interaction of onion value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers (AGGRA)
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Lack of onion innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>● Relatively High cost for individual small-scale farmer.</li> <li>● Limited awareness of the existence of machine by the farming community.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Establish Onion innovation platforms</li> <li>● Encourage group/cooperative ownership</li> <li>● Launch and awareness campaign through demonstrations and trainings</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>● Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>● Products from local/indigenous crops attract huge market, yet very little is being done to promote growth</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>● Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>● Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not determined
Estimated returns	Not determined
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● The implement will reduce the work burden of the various gender categories that perform the harvesting activity.</li> </ul>

	<ul style="list-style-type: none"> <li>• Women and youth have limited access credit to purchase the harvesting machine.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and males in operating the implement.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently.</li> <li>• VMGs have limited access to credit to purchase the farm implements.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth males in operating the implement.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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"> <li>• User manuals</li> <li>• Leaflets</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for up scaling;, 2-requires validation; 3-requires further research)	
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W, Pole F.N.
Partner organizations and contacts	Local Fabricators
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Training on local use and transportation will make it more usable.</li> <li>• Power tree pruner is affordable and could help VMGs exploit</li> </ul>
VMG related opportunities	Can create employment for VMG at local level

<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W, Pole F.N. Egerton University,

## 2.10 Agricultural Business and Marketing

<b>2.11.1.TIMP Name</b>	<b>Transformative Model of Onion production</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Small-scale onion production leading to market inefficiencies
What is it? (TIMP description)	An approach to organize farmers to transform from low volumes into commercial volumes. Buyer-driven model based on production organised by the end customer companies..
Justification	Without transformative model, onion farming will continue under developed leading to the decline in production and income
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Acceptance of smallholder farmers to form production organizations</li> <li>● Availability of investors</li> <li>● Prices of onions</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Formation of marketing groups, investments in onions production</li> <li>● County extension staff - Organization of farmers and technical service delivery</li> <li>● NGOs – Organization of farmers and service delivery</li> <li>● Private sector (local traders and exporters) – Support in input services and providing markets for the onions production</li> <li>● Research institutions – Availing improved seeds, backstopping</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kajiado, Nyeri, Nakuru and Kiambu
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu

Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Group dynamics</li> </ul>
	<ul style="list-style-type: none"> <li>● Limited investment by buyers</li> <li>● Prices of onions</li> <li>● Level of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of marketing groups</li> <li>● Small-scale farming – Aggregation of production</li> <li>● Group dynamics – Capacity building</li> <li>● Limited investment by buyers – County government support</li> <li>● Prices of onions – Setting minimum price</li> <li>● Level of policy support – price policy, subsidies, inputs support</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Production of onions without agreed buyers</li> <li>● Individual marketing instead of collective marketing</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – acceptability by the farmers, group dynamics, cultures</li> <li>● Environmental conditions – Enhancing natural resource management</li> <li>● Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, investment environment</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>● Women are widely discriminated in rural producer organizations</li> <li>● Women also have limited participation and influence in rural producer organizations</li> <li>● Socio-cultural norms may limit women’s participation and leadership in groups</li> <li>● Women’s double and triple roles means they may not have time to participate</li> <li>● Women’s status, age, wealth level may influence participation</li> <li>● Limited access to assets, resources and services, required to join producer groups</li> <li>● In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission</li> <li>● Strict rules of entry and requirements of producers’ organizations may limit women participation</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>Men and youth stand to benefit with higher profit margins through collective bargaining during marketing</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs are widely discriminated in rural producer organizations</li> <li>VMGs also have limited participation and influence in rural producer organizations</li> <li>Limited access to assets, resources and services, required to join producer groups</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>VMGs stand to benefit with higher profit margins through collective bargaining and marketing</li> <li>Opportunities exist for unemployed youth in production and marketing through ICT</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Models for production organization has been used in sorghum marketing
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

<b>2.11.2.TIMP Name</b>	<b>Building a Business Plan for onion farming Business</b>
Category (i.e. technology, Innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low management and lack sustainability and success in onion farming business due to lack of business plans.
What is it? (TIMP description)	An onion business plan will serve as an internal management and organizing tool, be used to communicate outside your business, or both?
Justification	With a business plan in hand, onion farmers and rural entrepreneurs will be able to take that first step toward the creation of a successful and sustainable business.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Education levels of the farmers and investors in onion production</li> <li>Levels of experiences in onion production</li> <li>Availability of information on onion production and marketing</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Users of business plans</li> <li>● County extension staff - Capacity building</li> <li>● NGOs – Capacity building</li> <li>● Private sector (local traders, exporters) – Buyers of onions</li> <li>● Research institutions – Capacity building</li> <li>● Financial Institutions – Financial support</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on onion production and marketing</li> <li>● Levels of policy support</li> <li>● Levels of education</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of production clusters</li> <li>● Small-scale farming – aggregation of production to assume large scale-farming</li> <li>● Inadequate information to stakeholders on the onion production – Developing information hub</li> <li>● Level of policy support – support in extension services</li> <li>● Levels of education – Capacity building</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Low adoption of business planning</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – Acceptable in Counties growing onion</li> <li>● Environmental conditions – Availability of water resources</li> <li>● Policy conditions – Policy support in opportunities selected</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>● High illiteracy levels of women leading to lack of record keeping and poor record keeping</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Some of the VMGs are illiterate hence cannot keep good records</li> </ul>

VMG related opportunities	<ul style="list-style-type: none"> <li>Those youths recovering from drugs HIVs have an opportunity to venture in this enterprise since they can be able to keep good farm record.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research GAPS

- 1 Impact of business plan on onion business
- 2 Adoption of business plan

<b>2.11.3..TIMP Name</b>	Collective marketing
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Individual farmer marketing increases inaccessibility to markets due to low volumes and low prices
What is it? (TIMP description)	Marketing as a group is a collective marketing approach. It involves formation of a group of farmers with an objective of reducing market inaccessibility.
Justification	Due to small-scale farming of onions, marketing as a group would enable farmers to gain from economies of scale. The advantages of collective marketing are bigger volumes, uniform quality, reliable sellers, reliable buyers, continuous supply, higher price and organization
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Production programme outlined</li> <li>Sell their produce before the collective sale</li> <li>The farmer is not able to deliver the agreed amount to the group</li> <li>Side-selling</li> <li>Bad weather</li> <li>Variable quality</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Defining production programme</li> <li>● County extension staff - Capacity building</li> <li>● NGOs – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on onion production and marketing</li> <li>● Defining production programmes of onion</li> <li>● Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of production clusters</li> <li>● Small-scale farming – aggregation of production to assume large scale-farming</li> <li>● Inadequate information to stakeholders on onion production – Developing information hub</li> <li>● Defining production programmes of onion – SWOT analysis</li> <li>● Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● Commitment: low commitment</li> <li>● Volume target: low volume due to side-sales</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – lack of trust among members</li> <li>● Environmental conditions – favourable condition for onion production</li> <li>● Policy conditions – Infrastructural support</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>● Women are widely discriminated in rural producer organizations</li> <li>● Women also have limited participation and influence in rural producer organizations</li> <li>● Socio-cultural norms may limit women’s participation and leadership in groups Women’s double and triple roles means they may not have time to participate in collective groups Limited access to assets, resources and services, required to join producer groups</li> <li>● Strict rules of entry and requirements of producers’ organizations may limit women participation</li> </ul>

Gender related opportunities	<p>Women are widely discriminated in rural producer organizations</p> <p>Women also have limited participation and influence in rural producer organizations</p> <p>Socio-cultural norms may limit women's participation and leadership in groups</p> <p>Women's double and triple roles means they may not have time to participate in collective groups</p> <p>Limited access to assets, resources and services, required to join producer groups</p> <p>Strict rules of entry and requirements of producers' organizations may limit women participation</p>
VMG issues and concerns in development and dissemination, adoption and scaling up	<p>VMGs are widely discriminated in rural producer organizations</p> <p>VMGs also have limited participation and influence in rural producer organizations</p> <p>Limited access to assets, resources and services, required to join producer groups</p>
VMG related opportunities	<p>VMGs stand to benefit with higher profit margins through collective bargaining and marketing</p> <p>Opportunities exist for unemployed youth in collective marketing through ICT</p>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

#### Research gaps

- Profitable opportunities
- Performance of marketing as a group

<b>2.11.4.TIMP Name</b>	<b>Profitability analysis</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Lack of profitability analysis by farmers, leading to lack of comparison of costs and returns

What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the onion agroenterprise
Justification	Profitability analysis reviews the management success and sustainability of the onion business. It indicates areas of adjustment
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Record keeping of costs and returns</li> <li>● Ability of farmers to keep records</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – record keeping</li> <li>● County extension staff - Facilitators</li> <li>● NGOs – Facilitators</li> <li>● Private sector (local traders and exporters) – Buyers</li> <li>● Research institutions – Facilitators</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Inability of farmers to keep records</li> <li>● Use of non-costed family labour in onion production</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Inability of farmers to keep records – capacity building</li> <li>● Use of non-costed family labour in onion production – capacity building on how to cost family labour</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up- scaling	<ul style="list-style-type: none"> <li>● Social conditions – Awareness on record keeping</li> <li>● Environmental conditions – suitable for the increased production of onion</li> <li>● Policy conditions – Policy support in costs of inputs and prices of outputs</li> <li>● Market conditions – Higher prices than costs</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram

Gender issues and concerns in development and dissemination, adoption and scaling	High illiteracy levels of women leading to lack of record keeping and poor record keeping.
Gender related opportunities	Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records.
VMG issues and concerns in development and dissemination, adoption and scaling up	Some of the VMGs are illiterate hence cannot keep good records.
VMG related opportunities	Those youths recovering from drugs HIVs have an opportunity to venture in this enterprise since they can be able to keep good farm record.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research GAPS

1. Investigation on strategies to reduce costs of production of onion
2. Investigation on price increasing strategies

<b>2.11.5.TIMP Name</b>	<b>Market research for onion farmers</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Knowledge asymmetries among the smallholder farmers leading to poor connectivity of smallholders to different markets,
What is it? (TIMP description)	Market research gathers information on the product buyer, demand, type required, minimum volume purchased, collective marketing volume, quality, packaging requirements, frequency of delivery, purchase price, means of payment and willing to buy from local farmers

Justification	Without market research the smallholder farmers will continue being market disintegrated, leading to low market participation
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Can the farmers increase production within their group</li> <li>• How will the farmers increase their production and sales (more technology, more land, more members)</li> <li>• Can the farmers work with other existing groups (available/not available)</li> <li>• Do the farmers need to form new groups</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Members of producer organization</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Targeted markets</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Issues related to increasing production from existing group</li> <li>• Issues related to increasing production from increasing size of existing groups</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Issues related to increasing production from existing group – farmers reach their new production target from the group members and farmers investing in new technology to achieve new targets</li> <li>• Issues related to increasing production from increasing size of existing groups – the first group help new farmers to develop an enterprise plan and the new farmers to join the existing groups or form an associated group</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – are there other farmers who want to join the group</li> <li>• Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group</li> <li>• Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>• Market conditions – new markets</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15

Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	Inadequate representation of women and youth in market research. Women have less access to market information than men.
Gender related opportunities	Employment opportunity exist for educated youths in market research
VMG issues and concerns in development and dissemination, adoption and scaling up	VMGs also have limited participation in market research. VMGs have less access to market information
VMG related opportunities	Employment opportunity exist for educated youths in market research.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b>	Requires validation
(1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research Gaps

1. Processes in scaling up
2. Effects of scaling up plan

2.11.6.TIMP Name	Contracted production model
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Market failure in onion production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves investment by the private companies, extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.

Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Can the farmers increase production while contracted?</li> <li>● How will the farmers increase their production and sales (more technology, more land, more members)?</li> <li>● Can the farmers work under contracted terms (available/not available)</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Members of producer organization</li> <li>● County extension staff - Capacity building</li> <li>● NGOs – Capacity building</li> <li>● Private sector (local traders and exporters) – Targeted markets</li> <li>● Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will	Kajiado, Nyeri, Nakuru, Kiambu
<b>2.11.7.TIMP Name</b>	<b>Marketing Innovation model</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Farmers' failure to apply entrepreneurship while marketing onions leading to low prices,
What is it? (TIMP description)	An entrepreneur farmer undertakes innovations and finance and business acumen in an effort to transform innovations into economic goods and ultimately profit.

Justification	Marketing innovation encourages product diversification. With the diversification, Diversification develops various marketing channels Failure to apply innovation in marketing of onion, the market outlook will be narrow
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Can the farmers increase production within their group</li> <li>● How will the farmers increase their production and sales (more technology, more land, more members)</li> <li>● Can the farmers work with other existing groups (available/not available)</li> <li>● Do the farmers need to form new groups</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Members of producer organization</li> <li>● County extension staff - Capacity building</li> <li>● NGOs – Capacity building</li> <li>● Private sector (local traders and exporters) – Targeted markets</li> <li>● Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Issues related to increasing production from existing group</li> <li>● Issues related to increasing production from increasing size of existing groups</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Issues related to increasing production from existing group – farmers reach their new production target from the group members and farmers investing in new technology to achieve new targets</li> <li>● Issues related to increasing production from increasing size of existing groups – the first group help new farmers to develop an enterprise plan and the new farmers to join the existing groups or form an associated group</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – are there other farmers who want to join the group</li> <li>● Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group</li> <li>● Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>● Market conditions – new markets</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15

Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to knowledge and information on contract farming than men</li> <li>• Women have less access to land for farming than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to knowledge and information on contract farming than men</li> <li>• VMGs have less access to land for farming than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b>	Requires validation
(1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research Gaps

3. Processes in scaling up
4. Effects of scaling up plan

<b>2.11.8.TIMP Name</b>	<b>Internet/mobile marketing</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited use of technologies among the smallholder farmers while linking to markets, leading to poor market access and constraints in marketing channels, skills and market information

What is it? (TIMP description)	Internet/mobile marketing refers to the <b>online marketplace that provides buyers and sellers with an avenue to meet and exchange goods and services</b> These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet/mobile marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Can the farmers increase production within their group</li> <li>● How will the farmers increase their production and sales (more technology, more land, more members)</li> <li>● Can the farmers work with other existing groups (available/not available)</li> <li>● Do the farmers need to form new groups</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Members of producer organization</li> <li>● County extension staff - Capacity building</li> <li>● NGOs – Capacity building</li> <li>● Private sector (local traders and exporters) – Targeted markets</li> <li>● Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kajiado, Nyeri, Nakuru, Kiambu
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Issues related to increasing production from existing group</li> <li>● Issues related to increasing production from increasing size of existing groups</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Issues related to increasing production from existing group – farmers reach their new production target from the group members and farmers investing in new technology to achieve new targets</li> <li>● Issues related to increasing production from increasing size of existing groups – the first group help new farmers to develop an enterprise plan and the new farmers to join the existing groups or form an associated group</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – are there other farmers who want to join the group</li> <li>• Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group</li> <li>• Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>• Market conditions – new markets</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to the required tools such as phones and computer than men.</li> <li>• Women are more illiterate and therefore cannot use the ICTs compared with men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to the required tools such as phones and computer than men.</li> <li>• VMGs are more illiterate and therefore cannot use the ICTs compared with men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b>	Requires validation

(1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research Gaps

- Processes in scaling up
- Effects of scaling up plan

## 2.11. Agricultural Policy Options

<b>2.12.1.TIMP Name</b>		<b>National Agricultural policy strategy framework</b>
Category (i.e. technology, Innovation or management practice)	Management practice	
<b>A: Description of the technology, innovation or management practice</b>		
Problem addressed	A policy towards the agricultural sector as a whole, or towards one particular interest group such as food consumers, grain producers, onion producers or fertilizer manufacturers can be characterised as consisting of three sets of aspects: objectives, instruments of policy and rules for operating instruments of policy.	
What is it? (TIMP description)	Agricultural policies for supporting onion output are based at farm and market levels. The policy objective is to increase onion output. The policy instruments chosen might be to incentivize onion production, such as an import tax or a production subsidy, an instrument to reduce the cost of production such as an input subsidy or capital grant and an instrument which reduces returns to products which compete onion for land, thus causing substitution of resources into onion production.	
Justification	Agricultural policies for supporting onion value chain are a great incentive for catalyzing investment by various actors from the supply of inputs to marketing. This in effect triggers demand for improved varieties. For instance, a policy instrument on subsidy can reduce the cost of production and hence attract many producers to switch farm enterprises and prioritize onion production.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Farmers, Traders, Retailers, Researchers, Processing industries, Public and Private Extension Providers, NGOs	
Approaches to be used in dissemination	Meetings, Mass Media, Social Media (WhatsApp, Facebook, twitter), Farmers' Groups, Agricultural Innovation Platforms	
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of stakeholders</li> <li>● Availability of agricultural policies and specific onion-based policies</li> <li>● Issues in onion business</li> <li>● Specific policy objective statement</li> </ul>	
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Demanding onion policies to support production and marketing</li> <li>● County extension staff - Sensitization of farmers</li> <li>● NGOs – Sensitization of farmers</li> <li>● Private sector (local traders and exporters) – Demanding onion policies to support production and marketing</li> <li>● Research institutions – Sensitization of stakeholders</li> </ul>	
<b>C: Current situation and future scaling up</b>		

Counties where already promoted if Any	None
Counties where TIMPs will be up Scaled	All Counties where onion farming is an important activity
Challenges in dissemination	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers (Farmers not organized into farmer groups)</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>● Poorly established onion value chain</li> <li>● Onion production are specific to agro-ecological zones and not all the Counties in Kenya grow onion</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>● Small-scale farming – Policies for increasing productivity</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>● Poorly established onion value chain – strengthening onion value chain</li> <li>● Onion production are specific to agro-ecological zones and not all the Counties in Kenya grow onion – Diversification of onion</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – Acceptability of the policies</li> <li>● Environmental conditions – lack of a comprehensive land use policy</li> <li>● Policy conditions – Lacking specific onion policy</li> <li>● Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<p>Inadequate representation of youth and women in policy development forums at all levels.</p> <p>Inadequate representation of youth and women in the policy of validation process.</p>
Gender related opportunities	Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	<p>Inadequate representation of VMGs in policy development forums at all levels.</p> <p>Inadequate representation of VMGs in the policy of validation process.</p>

VMG related opportunities	Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research GAPS

3. Adoption of policy options
4. Equity distribution among the stakeholders
5. Productivity levels among the smallholder farmers due to farmer-market linking models
6. Farmer accessibility to production inputs

<b>2.12.2.TIMP Name</b>	<b>County Integrated Development Planning</b>
Category (i.e. technology, Innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Lack of centralizing the smallholder agency and voices in planning agricultural development issues in Kenya
What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in cabbage production, marketing and processing are considered. .
Justification	Failure to consider onion issues during planning would lead to omission in the development funding.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions,
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of stakeholders</li> <li>● Availability of agricultural policies and specific onion-based policies</li> <li>● Issues in onion business</li> </ul>
	<ul style="list-style-type: none"> <li>● Specific policy objective statement</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – Demanding onion policies to support production and marketing</li> <li>● County extension staff - Sensitization of farmers</li> <li>● NGOs – Sensitization of farmers</li> <li>● Private sector (local traders and exporters) – Demanding onion policies to support production and marketing</li> <li>● Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All Counties where onion farming is an important activity
Challenges in dissemination - development and	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>● Poorly established onion value chain</li> <li>● Onion production are specific to agro-ecological zones and not all the Counties in Kenya grow onion</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>● Small-scale farming – Policies for increasing productivity</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>● Poorly established onion value chain – strengthening onion value chain</li> <li>● Onion production are specific to agro-ecological zones and not all the Counties in Kenya grow onion – Diversification of onion</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – Acceptability of the policies</li> <li>● Environmental conditions – lack of a comprehensive land use policy</li> <li>● Policy conditions – Lacking specific onion policy</li> <li>● Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15

Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels.</li> <li>• Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of VMGs in policy development forums at all levels.</li> <li>• Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research GAPS

1. Adoption of policy options
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. TIMP Name	Instruments of policy related to onions
Category innovation practice) (i.e. or technology, management	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Failure to implement policy objectives related to onions Instruments to achieve policy
What is it? (TIMP description)	<b>Policy instruments are the means to achieve policy objectives</b>

Justification	Methods of attempting to achieve policy objectives may take a wide variety of forms. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability effect, will also have some impact on the other objectives
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of policy objectives</li> <li>● Availability of policy instruments</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – beneficiaries of policy instruments</li> <li>● County extension staff - Sensitization of farmers</li> <li>● NGOs – Sensitization of farmers</li> <li>● Private sector (local traders and exporters) – beneficiaries</li> <li>● Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All Counties where onion farming is an important activity
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>● Poorly established onion value chain</li> <li>● Onions production are specific to agro-ecological zones and not all the Counties in Kenya grow onions</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>● Small-scale farming – Policies for increasing productivity</li> <li>● Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>● Poorly established onion value chain – strengthening onion value chain</li> <li>● Onions production are specific to agro-ecological zones and not all the Counties in Kenya grow onions – Diversification of onions</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – Low understanding of policy instruments</li> <li>● Environmental conditions – lack of a comprehensive land use policy</li> </ul>
	<ul style="list-style-type: none"> <li>● Policy conditions – Lacking specific onion policy</li> <li>● Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	

Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels.</li> <li>• Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of VMGs in policy development forums at all levels.</li> <li>• Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

### Research Gaps

1. Validation of policy instruments
2. Equity distribution among the stakeholders
3. Farmer accessibility to production inputs markets
4. Farmers accessibility to output markets

<b>2.12.4TIMP Name</b>	<b>Policy cycle</b>
Category (i.e. technology, Innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	

Problem addressed	Policy cycle is a valuable device for new policy development. It is a tool which divides complex policy procedures into convenient and manageable steps. These individual steps provides a frame work and antedates any forthcoming issues related to policy development
What is it? (TIMP description)	The policy cycle is usually divided into five stages: agenda setting, formulation, implementation, and evaluation
Justification	The policy cycle creates the need for a policy based on the agricultural problem emergence/issues. The policy cycle is an idealised process that explains how policy should be drafted, implemented and assessed. It serves more as an instructive guide for those new to policy than as a practical strictly-defined process, but many organisations aim to complete policies using the policy cycle as an optimal model. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. These steps are flexible enough to incorporate any changes at the time of new policy development and as a part of continuous change once it is implemented.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research Institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>● Availability of stakeholders</li> <li>● The stages of problem emergence, formulation, implementation and evaluation</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>● Farmers – generate issues</li> <li>● County extension staff - capacity building</li> <li>● NGOs – capacity building</li> <li>● Private sector (local traders and exporters) – generate issues</li> <li>● Research institutions – capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All Counties where onion farming is an important activity
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers</li> <li>● Small-scale farming</li> <li>● Inadequate information to stakeholders on issues</li> </ul>
	<ul style="list-style-type: none"> <li>● Poorly established onion value chain</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>● Disorganization and scattered farmers – issues on formation of producer organizations as an institution</li> <li>● Small-scale farming – issues on aggregation</li> <li>● Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages</li> <li>● Poorly established onions value chain – strengthening onion value chain</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>● None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>● Social conditions – Different issues among the onion producers</li> <li>● Environmental conditions – environmental issues</li> <li>● Policy conditions – Lacking specific onion policy</li> <li>● Market conditions – Market issues</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 250,000. One acre of land will produce at least 16,000 kilos of onion bulbs. Cost per kilogram is about Ksh 15
Estimated returns	Onion farming can give you an income of Ksh 354,000 per acre (This after deducting your expenses). Approximately Ksh 22 per kilogram
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>● Inadequate representation of youth and women in policy development forums at all levels.</li> <li>● Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>● Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>● Inadequate representation of VMGs in policy development forums at all levels.</li> <li>● Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>● Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director, KALRO HRI Kandara
Lead organization and scientists	KALRO Kandara – Dr. Jesca Mbaka
Partner organizations	

1. Analysis of policy model
2. Impact on the new policy on onion production and marketing



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