



# Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Finger Millet Value Chain



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**OCTOBER 2022**

## **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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#### **Published by**

Kenya Agricultural and Livestock Research Organization

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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 Finger Millet 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 Finger Millet 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 Finger Millet 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**

## Table of Contents

DISCLAIMER .....	i
FOREWORD .....	ii
PREFACE.....	iii
ABBREVIATIONS AND ACRONYMS .....	vi
1.0 Definition of terms and summary tables of Finger Millet Technologies, Innovations and Management Practices (TIMPS).....	7
1.1 Definition of terms.....	7
1.2 Summary of Inventory of TIMPs in the Finger Millet Value Chain .....	8
1.3 Summary of Status of TIMPs in Finger Millet Value Chain .....	8
2.0 Detailed Finger Millet Value chain TIMPs .....	14
2.1 Improved Finger Millet varieties .....	14
2.2 Good Agricultural Practices (Gaps) And Food Safety Management Systems .....	55
2.3 Agronomic Practices for Finger Millet .....	61
2.4 Soil Fertility Management .....	69
2.5 Soil and Water Management.....	77
2.6 Finger Millet Crop Health.....	107
2.7 Harvesting and Postharvest Management.....	172
2.8. Value Addition.....	184
2.9. Mechanization of Finger Millet Production Activities .....	201
2.10. Finger Millet Farming Business and Marketing Practices.....	220

## **ABBREVIATIONS AND ACRONYMS**

AEZ	Agro-ecological zone
ASALs	Arid and Semi-Arid Lands

## **1.0 Definition of terms and summary tables of Finger Millet Technologies, Innovations and Management Practices (TIMPS)**

### **1.1 Definition of terms**

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

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

## 1.2 Summary of Inventory of TIMPs in the Finger Millet Value Chain

The inventory process resulted in a total of 85 TIMPs including 26 technologies, 16 innovations and 43 management practices, distributed among the 4 sub-themes, as indicated in Table 1

**Table 1: Summary of Technology, Innovations and Management Practices**

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Finger Millet	Improved Finger Millet Varieties	15	0	0
Finger Millet	Good Agricultural Practices and Food Safety Management System	0	0	2
Finger Millet	Agronomic practices	0	0	3
Finger Millet	Soil Fertility Management	0	0	3
Finger Millet	Soil and Water Management	0	1	9
Finger Millet	Crop Health	4	6	10
Finger Millet	Postharvest Management	0	1	4
Finger Millet	Value Addition	0	8	0
Finger Millet	Mechanization	7	0	0
Finger Millet	Business and Marketing practices	0	0	8
Finger Millet	Agricultural Policy options	0	0	4
<b>Overall Total</b>		<b>26</b>	<b>16</b>	<b>43</b>

## 1.3 Summary of Status of TIMPs in Finger Millet Value Chain

The inventory process resulted in a total of 22 TIMPs that are ready for up scaling, 14 TIMPs that require validation and all TIMPs require further research for better performance as indicated in Table 2.

Table 3 provides the inventory of the identified Technologies, Innovations and Management Practices for finger millet production. The comprehensive description for each is detailed in Section 2 of this document.

**Table 2: Number of TIMPs ready for up-scaling, 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>
Finger Millet	Improved Finger Millet varieties	12	3	4
Finger Millet	Good Agricultural Practices and Food Safety Management Systems	2	0	0
Finger Millet	Agronomic practices	3	0	0
Finger Millet	Soil Fertility Management	1	2	0
Finger Millet	Soil and Water Management	9	0	1
Finger Millet	Crop health	7	9	1
Finger Millet	Postharvest Management	5	0	0
Finger Millet	Value Addition	6	1	0
Finger Millet	Mechanization	7	0	0
Finger Millet	Business and Marketing practices	7	1	0
Finger Millet	Agricultural Policy options	0	4	0
<b>Overall Total</b>		<b>59</b>	<b>20</b>	<b>6</b>

**Table 3: Inventory of Finger Millet 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 Finger Millet varieties</b>	<b>2.1.1</b> Finger Millet Variety Maridadi	Technology	Ready for up-scaling
	<b>2.1.2</b> Finger Millet Variety KAK-Wimbi 1	Technology	Ready for up-scaling
	<b>2.1.3</b> Finger Millet Variety KAK-Wimbi 3	Technology	Ready for up-scaling
	<b>2.1.4</b> Finger Millet Variety KAK-Wimbi 2	Technology	Ready for up-scaling
	<b>2.1.5</b> Finger Millet Variety KAK-Wimbi 4	Technology	Ready for up-scaling Requires further research
	<b>2.1.6</b> Finger Millet Variety P-224	Technology	Ready for up-scaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
			Requires further research
	2.1.7 Finger Millet Variety KACIMMI 65	Technology	Requires validation
	2.1.8 Finger Millet Variety GBK 043254	Technology	Requires validation
	2.1.9 Finger Millet Variety KACIMMI 49	Technology	Requires validation
	2.1.10 Finger Millet Variety Nakuru 1	Technology	Ready for up-scaling Requires further research
	2.1.11 Finger Millet Variety KAT FM 1	Technology	Ready for up-scaling Requires further research
	2.1.12 Finger Millet Variety MSU FM 60D	Technology	Ready for up-scaling, Requires further research
	2.1.13 Finger Millet Variety EUFM 401	Technology	Ready for up-scaling, Requires further research
	2.1.14 Finger Millet Variety EUFM 502	Technology	Ready for up-scaling, Requires further research
	2.1.15 Finger Millet Variety EUFM 503	Technology	Ready for up-scaling, Requires further research
<b>2.2. Good Agricultural Practices and Food Safety Management Systems</b>	2.2.1. Good Agricultural Practices for Finger Millet Production	Management practice	Ready for upscaling
	2.2.2. Food Safety Management Systems Hazards Analysis Critical Control Points (HACCP)	Management practice	Ready for upscaling
<b>2.3 Agronomic practices</b>	2.2.1 Planting Finger Millet in rows	Management Practice	Ready for up-scaling
	2.2.2. Use of fertilizer in Finger Millet cultivation	Management Practice	Ready for up-scaling
	2.2.3 Timely/Early planting	Management Practice	Ready for upscaling
<b>2.4 Soil Fertility Management</b>	2.4.1 Integrated Manure Management	Management practice	Ready for upscaling
	2.4.2 Integrated Soil Fertility Management	Management practice	Requires validation
	2.4.3 Rapid soil testing	Management Practice	Requires validation
	2.5.1 Contour bunds	Management practice	Ready for upscaling


<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.5. Soil and Water Management</b>	2.5.2 <i>Zai</i> pits	Management practice	Ready for upscaling
	2.5.3 Bench Terraces	Management practice	Ready for upscaling
	2.5.4 Fanya Juu Terraces	Management practice	Ready for upscaling
	2.5.5 Stone lines	Management practices	Ready for upscaling
	2.5.6 Retention ditches	Management practice	Ready for upscaling
	2.5.7 Grass strips	Management practice	Ready for upscaling
	2.5.8 Tied Ridges/Ridging/Earthing up	Management practice	Ready for upscaling
	2.5.9 Rain Water Harvesting Systems	Management practice	Ready for upscaling
	2.5.10 Conservation Agriculture	Innovation	Requires further research
	<b>2.6 Crop health</b>	2.6.1 Scouting for timely identification and control of Finger millet pests and diseases.	Management practice
2.6.2 Cultural management of Shoot Fly ( <i>Atherigon asocata</i> ) in Finger millet		Management practice	Ready for upscaling
2.6.3 Identification of disease-free areas for production of Finger millet.		Management practice	Requires validation
2.6.4 Integrated Pest Management of Finger millet stem borer		Management practice	Ready for upscaling
2.6.5 Integrated Pest Management of Cut worms in Finger millet.		Management practice	Ready for upscaling
2.6.6 The use of soil amendments in suppressing soil borne pathogens of Finger millet (Leaf/Head blast and Millet smut.		Innovation	Requires validation
2.6.7 Control of Damping off of Finger millet by soil solarization.		Innovation	Requires validation
2.6.8 Integrated Pest Management of root, stem and foliar aphids in Finger millet.		Management practice	Ready for upscaling
2.6.9 Soil steam sterilization for the management of damping off and seedling blight diseases of Finger millet.		Innovation	Requires validation

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	2.6.10 Management of foliar diseases (Downy mildew and Cercospora leaf spot) of Finger millet by use of integrated disease management practices.	Management practice	Ready for upscaling
	2.6.11 Community rangeland rehabilitation to increase populations of natural enemies for pest management in Finger millet.	Management practice	Requires further research
	2.6.12. Integrated Weed Management in millet production	Innovation	Requires validation
	2.6.13 Intercropping System in millet production	Innovation	Ready for upscaling
	2.6.14. Mulching for weed management in millet production	Technology	Ready for upscaling
	2.6.15 Herbicide (Chemical) Weed Control in millet production	Technology	Requires validation
	2.6.16 Solarization Bed for Weed Control in millet	Technology	Requires validation
	2.6.17 Stale seed bed for Weed Control in millet	Technology	Requires validation
	2.6.18 Mechanical weed control in millet	Innovation	Requires validation
	2.6.19 Crop Rotation in Millet production	Management Practice	Requires validation
	2.6.20 Safe Use of herbicides in millet production	Management Practice	Ready for upscaling
<b>2.7. Postharvest Management</b>	2.7.1 Maturity and harvesting Techniques	Management practice	Ready for upscaling
	2.7.2 Reducing Postharvest Yield and Quality Losses in Finger Millet Production.	Innovation	Ready for upscaling
	2.7.3 Finger Millet threshing and winnowing	Management practice	Ready for upscaling
	2.7.4 Finger Millet grain drying.	Management practice	Ready for upscaling
	2.7.5 Finger Millet grain storage.	Management practice	Ready for upscaling
<b>2.8 Value Addition</b>	2.8.1 Finger Millet Crackie Snack Food Product.	Innovation	Ready for upscaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	2.8.2 Finger Millet TAMUU Paste Food Product.	Innovation	Ready for upscaling
	2.8.3 Finger Millet Onion Bites Food Product.	Innovation	Ready for upscaling
	2.8.4 Finger Millet Cake Food Product.	Innovation	Ready for upscaling
	2.8.5 Finger Millet Chapatti Food Product.	Innovation	Ready for upscaling
<b>2.9 Mechanization</b>	2.9.1 <b>Power Tiller.</b>	Technology	Ready for upscaling
	2.9.2 Four Wheeled Tractor 50Hp.	Technology	Ready for upscaling
	2.9.3 Mouldboard Plough.	Technology	Ready for upscaling
	2.9.4 Disk Harrow.	Technology	Ready for upscaling
	2.9.5 Small grain planter.	Technology	Ready for upscaling
	2.9.6 Motorised Sprayer.	Technology	Ready for upscaling
	2.9.7 Finger Millet Machine harvesting	Technology	Ready for upscaling
<b>2.10. Business and Marketing</b>	2.10.1 Transformative Model of Finger millet production.	Management practice	Ready for upscaling
	2.10.2 Building a Business Plan for Finger millet production.	Management practice	Ready for upscaling
	2.10.3 Collective marketing.	Management practice	Ready for upscaling
	2.10.4 Profitability analysis.	Management practice	Ready for upscaling
	2.10.5 Market research for Finger millet farmers.	Management practice	Ready for upscaling
	2.10.6 Contracted Finger millet production model.	Management practice	Ready for upscaling
	2.10.7 Marketing Innovation model.	Management practice	Ready for upscaling
	2.10.8 Internet/mobile marketing.	Management practice	Ready for upscaling
<b>2.11. Agricultural Policy options</b>	2.11.1 National Agricultural policy strategy framework.	Management practice	Requires validation
	2.11.2 County Integrated Development Planning.	Management practice	Requires validation
	2.11.3 Policy instruments related to Finger millet.	Management practice	Requires validation
	2.11.4 Policy cycle	Management practice	Requires validation

## 2.0 Detailed Finger Millet Value chain TIMPs

### 2.1 Improved Finger Millet varieties

2.1.1 TIMP Name		Finger Millet Variety Maridadi
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 yielding, lodging, non-synchronous in maturity, late maturity; pest and disease susceptible local finger millet varieties	
What is it? (TIMP description)	<p>It is an early maturing (90 – 120 days) synchronous in maturity; and high yielding variety (1,100 – 4,900 kg<math>ha^{-1}</math> depending on environment) that is resistant to Blast, <i>Striga</i>, and lodging; and tolerant to drought. Its characteristic features include; brown grain colour and purple nodal pigmentation; incurved fistlike panicles; most popular improved variety in western Kenya.</p> <p>Optimal environmental conditions: Rainfall (600- 900mm annually), altitude (0 – 1500 m.a.s.l.) and soils (well-draining loams).</p>	
		
Justification	<p>The variety, which was formally released in Kenya in 2015 is highly adopted in western Kenya. It is early maturing as demanded by farmers and breeders, high yielding, synchronous in maturity allowing one time harvesting, produces palatable and nutritious food products; popular with farmers in western Kenya where it has been demo. Because of early maturity, it is drought escaping and thus assurance of produce. Seed can be found at KALRO-Kakamega, Kisii, and Kibos for immediate up-scaling.</p>	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Farmers, extension agencies, processing industry, seed producers and traders	
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Training of Trainers (ToTs),</li> <li>• Extension publications (leaflets, booklets, posters etc.)</li> <li>• Farmer Field and Business Schools (FFBS)</li> <li>• Radio Stations, especially Local FM radios</li> <li>• Mobile/ ICT Apps;</li> <li>• Mobile Phone Short Message Service (sms)</li> <li>• Farmer group training</li> <li>• On-farm experimentation</li> <li>• Field days</li> <li>• Agricultural shows and trade fairs</li> <li>• Farmer to farmer communication</li> <li>• Plot demonstrations</li> </ul>	

	<ul style="list-style-type: none"> <li>• Distribution of small seed packets.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Participatory promotion</li> <li>• Variety defining traits - early maturity and crop uniformity</li> <li>• Stakeholder capacity building,</li> <li>• Functioning seed system to enable easy access to quality seed</li> <li>• Stakeholder networks,</li> <li>• Effective extension services</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>• Public and private partners – [MOALF&amp; Co-operatives) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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,</li> <li>• Aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing), and</li> <li>• 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>	
Counties where already promoted if	Western counties of Kakamega, Bungoma, Busia, Kericho, Bomet, Baringo, Tharaka Nithi Siaya
Counties where TIMPs will be upscaled	West Pokot, Meru, Embu, Kitui, Makueni, Machakos, Kilifi.
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low investment in crop development research– especially along the value chain</li> <li>• Fear of bird pests</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing, manufacturing and promotion);</li> <li>• Supportive policies like the recently passed blending policy,</li> <li>• Lifting of ban on traditional brews;</li> <li>• Positive publicity.</li> <li>• Agricultural Product Value Chain research - e.g. for ready to eat food products and brewing finger millet beer.</li> <li>• Planting crop on larger scale to mitigate bird damage</li> </ul>

Lessons learnt in up scaling, if any	<ul style="list-style-type: none"> <li>• Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya;</li> <li>• Stakeholder linkages and participatory implementation is important.</li> <li>• Early maturity and uniformity in maturity made variety highly acceptable.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Acceptability of the crop -Finger millet is socially acceptable and any technology to increase its production will be readily adopted.</li> <li>• Enabling policy frameworks e.g. in Big 4 Agenda, that requires the blending of high nutritive value food products, provides an enabling environment.</li> <li>• Early maturity makes it fit in reduced cropping season as a result of climate change.</li> <li>• The purplish brown grain colour meets the consumers demand for dark coloured grain.</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 commodity market.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 68,888/= and thus net benefit KES 38,638/=
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Labour intensity in weeding, threshing and winnowing – mostly done by women, therefore likely to overburden them;</li> <li>• Grain sales also by women, likely to increase their incomes.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased production and sales results in increased incomes for both women and youth.</li> <li>• Youth could also benefit through application of ICT networking for marketing.</li> <li>• Introduction of machines could create opportunities for youth and men employment.</li> <li>• The good palatability of the variety for food products will lead to production and trade in products thus economically empowering women and youth. This will also create employment.</li> <li>• Good threshability of the variety will ease labour on women and youth who thresh finger millet and hence more volumes of clean grain to be generated in shorter periods.</li> </ul>
VMG issues and concerns in development,	<ul style="list-style-type: none"> <li>• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved</li> </ul>

dissemination, adoption and scaling up	<p>technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</p> <ul style="list-style-type: none"> <li>• The crop is important for food and nutrition security; therefore, there is need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption.</li> <li>• Production is labour intensive; thus, need for mechanization/labour saving interventions to assist the majority women farmers.</li> <li>• Enhance market linkages to trigger increased production to benefit VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production of popular and high yielding variety will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value and demand of variety will lead to economic empowerment of VMGs.</li> <li>• Changing consumer behavior leading to increased demand hence improved incomes for VMGs</li> <li>• Employment opportunities for youth and VMGs due to enhanced production of the popular variety.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>The case of McKnight Foundation funded project in western Kenya and stories of individual farmers e.g.</p> <p>Aliaro Mapesa of Eburaya village, Musanda Ward, Mumias Sub-County in Kakamega County. He adopted finger millet Maridadi variety and associated management practices and within a few years of farming 3 acres he had replaced a large chunk of his sugar cane crop with finger millet, producing enough for his household consumption and sales surplus for his financial needs. His family ate finger millet and their health improved; he bought household goods, paid school fees for his children and in two years moved from his grass thatched house to his new permanent house constructed out of finger millet proceeds. He also bought a dairy cow. Today, he lives a better life than he did before adopting finger millet technologies.</p> <p>The same applies to Margaret Kubende of Matungu in Mumias Sub-County who adopted the variety in 2009 and has consistently cultivated the popular variety, increasing her acreage under the variety from less than half acre to 5 and above acres a year to date. She sells her grain to as far off customers as Mombasa.</p>
Application guidelines for users	Refer to the finger millet production leaflets in KALRO/ICRISAT e.g. Oduori C.O.A. 2018. Finger Millet Variety P-224: Plant Improved Finger Millet Varieties; Apply Good Agricultural Practices; Harvest More for Food and Money. KALRO FCRI, Kisii.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	1 – Ready for up scaling in all low to mid-altitude environments where finger millet is or can be grown.

<b>G: Contacts</b>	
Contacts	Centre Director, KALRO HRI-Kibos; P.O. Box 1490- 40100, KISUMU; e-mail address: <a href="mailto:chriscus.oduori@kalro.org">chriscus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori; Dr. Rhoda A. Nungo; Dr. Rachel A. Opole.
Partner organizations	<ul style="list-style-type: none"> <li>• ICRISAT Nairobi;</li> <li>• MoALF&amp;I,</li> <li>• County governments – Busia, Kakamega, Bungoma, and Siaya.</li> <li>• KEPHIS</li> <li>• Alliance for a Green Revolution in Africa (AGRA)</li> <li>• The McKnight Foundation</li> <li>• Egerton University</li> <li>• Kote Mtaani Health and Environment Concerns (KOMHEC)</li> </ul>

#### **Finger Millet Variety Maridadi Gaps**

1. Needs improvement to fit in wider agro-ecological zones
2. Needs improvement in yield and resistance to biotic and abiotic stresses.

<b>TIMP Name</b>	<b>Finger Millet Variety KAK-Wimbi 1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problems to be addressed	Low yielding, lodging, non-synchronous in maturity; pest and disease susceptible local finger millet varieties; lack of variety suitable for local beer brewing.
What is it? (TIMP description)	<p>It is a late maturing (88 – 138 days) and high yielding variety (1,140 – 6,670 kg/ha<sup>-1</sup> depending on environment). It is resistant to blast, Striga and lodging; and tolerant to drought. Characteristic features include; brown grain color, purple nodal pigmentation, robust plant type, stout stem, and large open purple panicles.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2500 m.a.s.l.) and soils (well-draining sand loams).</p>
Justification	The variety, which was released in Kenya in 2016, is high yielding (1,140 – 6,670 kg/ha <sup>-1</sup> depending on environment) compared to local and earlier released current commercial varieties yielding 1,200 - 4,900 kg/ha <sup>-1</sup> , with wide adaptability (AEZ). Its resistance to blast disease, Striga, lodging, tolerance to drought, and wide adaptability makes it a reliable variety to yield in most finger millet producing regions.



<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers and traders, processing industry and consumers, including local finger millet beer brewers.
Approaches used in development and dissemination	<ul style="list-style-type: none"> <li>• Training of Trainers (ToTs),</li> <li>• Extension publications (leaflets, booklets, posters etc.)</li> <li>• Farmer Field and Business Schools (FFBS)</li> <li>• Radio Stations, especially Local FM radios</li> <li>• Mobile/ ICT Apps;</li> <li>• Mobile Phone Short Message Service (sms)</li> <li>• Farmer group training</li> <li>• On-farm experimentation</li> <li>• Field days</li> <li>• Agricultural shows and trade fairs</li> <li>• Farmer to farmer communication</li> <li>• Plot demonstrations</li> <li>• Distribution of small seed packets.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Participatory promotion</li> <li>• Variety defining traits - early maturity and crop uniformity</li> <li>• Stakeholder capacity building,</li> <li>• Functioning seed system to enable easy access to quality seed.</li> <li>• Stakeholder networks and</li> <li>• Effective extension services</li> </ul>
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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,</li> <li>• Aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing, and</li> <li>• 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>	
Counties where already promoted if any	Western Kenya counties of Kakamega, Bungoma, Busia, and Siaya; Rift Valley counties of Bomet and Kericho.
Counties where TIMPs will be up-scaled	Nakuru, Trans-Nzoia, Uasin Gishu, Migori, Homa-Bay, and West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self- pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low investment in crop development research– especially along the value chain.</li> </ul>

	<ul style="list-style-type: none"> <li>• Fear of bird pests</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing, manufacturing and promotion);</li> <li>• Supportive policies like the recently passed blending policy,</li> <li>• Lifting of ban on traditional brews;</li> <li>• Positive publicity.</li> <li>• Agricultural Product Value Chain research - e.g. for ready to eat food products and brewing finger millet beer.</li> <li>• Planting crop on larger scale to mitigate bird damage</li> </ul>
Lessons learnt in up scaling, if any	<p>Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya;</p> <p>Stakeholder linkages and participatory implementation is important. Farmers can identify and select varieties with traits they value - this variety was selected for local beer.</p>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Acceptability of the crop -Finger millet is socially acceptable and any technology to increase its production will be readily adopted.</li> <li>• Enabling policy frameworks e.g. in Big 4 Agenda, that requires the blending of high nutritive value food products, provides an enabling environment.</li> <li>• Wide adaptability and resilience makes the variety fit in many agro-ecologies and climate change mitigation strategies.</li> <li>• The dark brown grain colour meets the consumers demand for dark coloured grain.</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 commodity market.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 76,161/= and thus net benefit KES 45,911/=
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Labour intensity in weeding, threshing and winnowing – mostly done by women, therefore likely to overburden them;</li> <li>• Grain sales also by women, likely to increase their incomes which may cause couple strife.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;</li> <li>• The perceived value of the variety in local brewing may enhance alcohol consumption and contribute to irresponsibility of some in their families.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased production and sales results in increased incomes for both women and youth.</li> </ul>

	<ul style="list-style-type: none"> <li>• Youth could also benefit through application of ICT networking for marketing.</li> <li>• Introduction of machines could create opportunities for youth and men employment.</li> <li>• The brewing value of the variety will spur local brewing and enhance social well-being of men.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• The crop is important for food and nutrition security; therefore, there is need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption.</li> <li>• Production is labour intensive; thus, need for mechanization/labour saving interventions to assist the majority women farmers.</li> <li>• Enhance market linkages to trigger increased production to benefit VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production of high yielding variety will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value and demand of variety will lead to economic empowerment of VMGs.</li> <li>• Changing consumer behavior leading to increased demand hence improved incomes for VMGs.</li> <li>• Employment opportunities for youth and VMGs due to enhanced production of the popular variety.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The case of KCSAP finger millet seed project seed production activity at Kiptere in Sigowet Sub-County, Kericho County in 2020-2021. The variety did very well and attracted neighbouring communities to plant finger millet.
Application guidelines for users	Refer to the finger millet production leaflets in KALRO/ICRISAT e.g. Oduori C.O.A. 2018. Finger Millet Variety P-224: Plant Improved Finger Millet Varieties; Apply Good Agricultural Practices; Harvest More for Food and Money. KALRO FCRI, Kisii.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling in all environments where finger millet is grown.
<b>G: Contacts</b>	
Contacts	Centre Director KALRO – HRI Kibos P.O. Box 1490-40100, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori; Dr. Rhoda A. Nungo; Dr. Rachel A. Opole.

Partner organizations	<ul style="list-style-type: none"> <li>• ICRISAT Nairobi;</li> <li>• MoALF&amp;C,</li> <li>• County governments – Busia, Kakamega, Bungoma, Siaya, Kericho, and Bomet.</li> <li>• KEPHIS</li> <li>• Alliance for a Green Revolution in Africa (AGRA)</li> <li>• The McKnight Foundation</li> <li>• Egerton University</li> <li>• Kote Mtaani Health and Environment Concerns (KOMHEC)</li> </ul>
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### KAK-Wimbi 1 Gaps

1. Needs improvement in organoleptic taste
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs reduction in maturity period for low moisture environments

TIMP Name	Finger Millet Variety KAK-Wimbi 3
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problems to be addressed	- Low yielding, lodging, non-synchronous in maturity; pest and disease susceptible local finger millet varieties..
What is it? (TIMP description)	<p>It is a late maturing (87 – 130 days) and high yielding variety (1290 – 6,350 kg/ha<sup>-1</sup> depending on environment); resistant to blast, Striga and lodging; and, tolerant to drought. Characteristic features include; brown grain color, purple nodal pigmentation, robust plant type, thick stout stem, and large open panicles.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2500 m.a.s.l.) and soils (well-draining sandy loams).</p>
Justification	The variety, which was released in Kenya in 2016, is high yielding (1290 – 6,350 kg/ha <sup>-1</sup> depending on environment) compared to local and earlier released commercial varieties yields of 1200 - 4,900kg/ha <sup>-1</sup> , with wide adaptability (AEZ), It can be grown and yield in most finger millet growing environments.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers, traders, processing industry and consumers




Approaches used in development and dissemination	<ul style="list-style-type: none"> <li>• Training of Trainers (ToTs),</li> <li>• Extension publications (leaflets, booklets, posters etc.)</li> <li>• Farmer Field and Business Schools (FFBS)</li> <li>• Radio Stations, especially Local FM radios</li> <li>• Mobile/ ICT Apps;</li> <li>• Mobile Phone Short Message Service (sms)</li> <li>• Farmer group training</li> <li>• On-farm experimentation</li> <li>• Field days</li> <li>• Agricultural shows and trade fairs</li> <li>• Farmer to farmer communication</li> <li>• Plot demonstrations</li> <li>• Distribution of small seed packets.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Participatory promotion</li> <li>• Variety defining traits - early maturity and crop uniformity</li> <li>• Stakeholder capacity building,</li> <li>• Functioning seed system to enable easy access to quality seed</li> <li>• Stakeholder networks,</li> <li>• Effective extension services</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp; Co-operatives) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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,</li> <li>• Aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing), and</li> <li>• 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>	
Counties where already promoted if any	Western counties of Kakamega, Bungoma, Busia, and Siaya and Rift Valley counties of Kericho and Bomet.
Counties where TIMPs will be up-scaled	Bomet, Kericho, Uasin Gishu, West Pokot, Nakuru, Kisii, Nyamira, Trans-Nzoia.
Challenges in development and dissemination	Negative attitude to the crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line-self-pollinating crops; limited utilization products; low research investment.

Suggestions for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity; Conduct variety awareness and preference socioeconomic study.
Lessons learned in up scaling, if any	Investment in the crop and participation of champions enhances technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; Capacity building of stakeholders; understanding of the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 72,280/= and thus net benefit KES 42,030/=
Gender issues and concerns in development and dissemination adoption and scaling up	Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them; Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;
Gender related opportunities	Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop). Youth could also benefit through application of ICT networking for marketing.
VMG issues and concerns in development and dissemination adoption and scaling up	The crop is important for food and nutrition security; therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption. Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs. Changing consumer behavior leading to increased demand hence improved incomes for VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	The case of McKnight Foundation funded project in western Kenya and stories of individual farmers e.g. Julius Kwoba in Nambale, Busia County.
Application guidelines for users	Refer to the finger millet production leaflets in KALRO/ICRISAT e.g. Oduori C.O.A. 2018. Finger Millet Variety P-224: Plant Improved Finger Millet Varieties; Apply Good Agricultural Practices; Harvest More for Food and Money. KALRO FCRI, Kisii.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling

<b>G: Contacts</b>	
Contacts	Centre Director KALRO – FCRI Kisii P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I, Counties Governments of Busia, Kakamega, Bungoma, and Siaya.

### **KAK-Wimbi 3 Gaps**

1. Needs improvement in organoleptic taste
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs reduction in maturity period for low moisture environments


<b>TIMP Name</b>	<b>Finger Millet Variety KAK-Wimbi 2</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problems to be addressed	- Low finger millet yield
What is it? (TIMP description)	It is a late maturing (88 – 131 days) and high yielding variety (1320 – 6,060kg $ha^{-1}$ depending on environment); that is resistant to; blast, Striga and lodging; and, tolerant to drought. Its characteristic features include; dark brown grain color, deep purple plant pigmentation, erect plant type, medium size straight panicles.  Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2500 m.a.s.l.) and soils (well-draining loams).
	
Justification	The variety, which was released in Kenya in 2016, is very high yielding (1320 – 6,060 kg $ha^{-1}$ depending on environment) compared to the current commercial varieties (1200 - 4,900kg/ha $^{-1}$ ), respectively, with wide adaptability (AEZ)
Counties where variety was tested and promoted	Not yet extensively tested.
Counties where the TIMP will be promoted	Western Kenya counties of Kakamega, Bungoma, Busia, Nyamira, Kisii, Migori, Bomet, Kericho and West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, processing industry and consumers
Approaches used in development and dissemination	Hybridization breeding and pure line selection, Not yet disseminated but On-farm experimentation and demonstration, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations will be applied.
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building, functioning seed system, stakeholder networks and effective extension services.

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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 development and dissemination	Negative attitude to the crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line-self-pollinating crops; limited utilization products; low research investment.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity;</li> <li>• Conduct variety awareness and preference socioeconomic study.</li> </ul>
Lessons learned in up scaling, if any	Investments in the crop and participation of champions enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 71,300/= and thus net benefit KES 41,050/=
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them;</li> <li>• Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth could also benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development and dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• The crop is important for food and nutrition security; therefore, need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption.</li> </ul>

	<ul style="list-style-type: none"> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.</li> <li>• Changing consumer behavior leading to increased demand hence improved incomes for VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Not yet extensively disseminated..
Application guidelines for users	Refer to the finger millet production leaflets in KALRO/ICRISAT e.g. Oduori C.O.A. 2018. Finger Millet Variety P-224: Plant Improved Finger Millet Varieties; Apply Good Agricultural Practices; Harvest More for Food and Money. KALRO FCRI, Kisii.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling with validation in areas it has not been disseminated.
<b>G: Contacts</b>	
Contacts	Centre Director KALRO – FCRI Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I, Counties Governments of Busia, Kakamega, Bungoma, Siaya, Bomet, Kericho, and West Pokot.

### KAK-Wimbi 2 Gaps

1. Needs improvement in yield and resistance to biotic and abiotic stresses
2. Needs reduction in maturity period for low moisture environments
3. Needs enhancement in vigor

<b>TIMP Name</b>	<b>Finger Millet Variety KAK-Wimbi 4</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problems to be addressed	- Low finger millet yield
What is it? (TIMP description)	<p>It is a late maturing (87 – 130 days) and high yielding variety (1400 – 5500 kg<math>ha^{-1}</math> depending on environment); that is tolerant to blast and drought, and resistant to Striga and lodging. Its characteristic features include; brown grain color, dark green robust erect plant type, and large open incurved panicles.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2500 m.a.s.l.) and soils (well-draining loams).</p>
	

Justification	The variety, which was released in Kenya in 2016, is very high yielding (1400 – 5,500 kg/ha <sup>-1</sup> ) compared to the current commercial varieties (1200 - 4,900kg/ha <sup>-1</sup> ), depending on environment) versus respectively, with wide adaptability (AEZ)
Counties where already promoted if any	Tested in western counties of Kakamega, Bungoma, Busia, and Siaya with limited dissemination.
Counties where TIMP will be upscaled	Western Kenya counties of Kakamega, Bungoma, Busia, Nyamira, Kisii, Migori, Bomet, Kericho and West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, processing industry and consumers
Approaches used in development and dissemination	Hybridization breeding and pure line selection, Not yet disseminated but On-farm experimentation and demonstration, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations will be applied.
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building, functioning seed system, stakeholder networks and effective extension services.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to the crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research investment.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> <li>• Supportive policies like the recently passed blending policy,</li> <li>• Lifting of ban on traditional brews;</li> <li>• Positive publicity;</li> <li>• Conduct variety awareness and preference socioeconomic study.</li> </ul>
Lessons learned in up scaling, if any	Investment in the crop and participation of champions enhances technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.

Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders;</li> <li>• Understanding the physical and biotic environment in target ecologies;</li> <li>• Understanding community culture, preferences, and practices</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 72,000/= and thus net benefit KES 41,750/=
Gender issues and concerns in development, dissemination, adoption, and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them; Grain is sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth could also benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects. The crop is important for food and nutrition security; therefore, need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.</li> <li>• Changing consumer behavior, leading to increased demand hence improved incomes for VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The case of McKnight Foundation funded project in western Kenya and stories of individual farmers e.g. Julius Kwoba in Nambale, Busia County.
Application guidelines for users	Refer to the finger millet production leaflets in KALRO/ICRISAT e.g. Oduori C.O.A. 2018. Finger Millet Variety P-224: Plant Improved Finger Millet Varieties; Apply Good Agricultural Practices; Harvest More for Food and Money. KALRO FCRI, Kisii.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling
<b>G: Contacts</b>	

Contacts	Centre Director KALRO – FCRI Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I, Counties Governments of Busia, Kakamega, Bungoma, and Siaya.

### KAK-Wimbi 4 Gaps

1. Needs improvement in blast disease resistance
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs reduction in maturity period for low moisture environments

TIMP Name	Finger Millet Variety P-224
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Low finger millet yield.
What is it? (TIMP description)	<p>A high yielding finger millet variety (1200 - 4,900kg/ha<sup>-1</sup>, depending on environment) that is moderately early in maturity (95 – 125 days). Characteristic features include brown grain color with no anthocyanins (colours) on leaves, nodes, and panicles. Also, it has large open panicles with prominent grains; it is prone to post maturity lodging, moderately susceptible to blast disease and susceptible to Striga.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2500 m.a.s.l.) and soils (well-draining loams). Has wide environmental adaptability.</p>
Justification	The first formally released variety in Kenya in 1991; one of few whose seed is certified by KEPHIS and commercially produced by Kenya Seed Company and KALRO Seed Unit ; very high yielding under favorable conditions; significant seed stocks available.
Counties where TIMP will be promoted	Bomet, Kericho and West Pokot.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches 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 capacity building, Functioning seed system, Stakeholder networks and efficient extension service.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <li>• Farmer Groups for activity implementation and promotion</li> </ul>




	<ul style="list-style-type: none"> <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>	
Current extent of reach	Western Kenya counties of Kakamega, Bungoma, Busia and Siaya. Many other pockets in the country where seed has penetrated also grow the variety.
Challenges in development and dissemination	Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line-self-pollinating crops; limited utilization products; low research investment.
Recommendations for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity; Conduct variety awareness and preference socioeconomic study.
Lessons learned in up-scaling if any?	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; Capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, consumer preferences and social practices.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 63,000/= and thus net benefit KES 32,750/=
Gender issues and concerns in development, dissemination, adoption and scaling up	Labor intensity in weeding, threshing and winnowing (variety has poor threshability and dusty thus aggravating labor intensity) – mostly done by women; Grain sales also done by women; therefore likely to overburden them but also benefit them and likely to improve the women’s livelihood. . Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men
Gender issues and concerns in development and dissemination adoption and scaling up	Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them; Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;
Gender related opportunities	- Enhance women training for improved performance

	<ul style="list-style-type: none"> <li>- Increased incomes for Women from increased grain sales (this is considered largely as a women's crop).</li> <li>- Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects. Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	The case of McKnight Foundation funded project in western Kenya and stories of individual farmers e.g. Julius Kwoba in Nambale, Busia County.
Application guidelines for users	Finger millet variety P-224 production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling as improvement for resistance (blast disease, Striga, and lodging) and improved threshability.
<b>G: Contacts</b>	
Contacts	Centre Director KALRO – FCRI Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Busia, Kakamega, Bungoma, and Siaya.

### Variety P-224 Gaps

1. Needs improvement in blast, Striga, drought, and lodging resistance
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs reduction in maturity period for low moisture environments

<b>TIMP Name</b>	<b>Finger Millet Variety KACIMMI 65</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problems to be addressed	- Late maturity in mid to low moisture supply areas; Finger millet low yield.

	<p>It is an early maturing (87 – 118 days) and high yielding variety (1,335 – 4,010 kg<sup>ha</sup><sup>-1</sup> depending on environment) that is resistant; to Blast, <i>Striga</i>, and lodging; and tolerant to drought. Its characteristic features include; brown grain color and with no pigmentation.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2,000 m.a.s.l.) and soils (well-draining loams).</p> <p><b>Features:</b> Brown grain color; no pigmentation; medium height; high tillering; medium size open panicles</p>
Justification	-Variety in National Performance Trials and has potential for release to serve short rain season areas in Kenya; very high yielding variety with wide adaptability.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	Not yet disseminated but method used in dissemination of successful technologies to be adopted i.e. 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 capacity building, Functioning seed system, Stakeholder networks
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Not yet promoted as it is still undergoing verification in National Performance Trials.
Counties where TIMPs will be upscaled	Bomet, Kericho and West Pokot
Challenges in development and dissemination	Not yet disseminated but expected challenges :- Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line-self-pollinating crops; limited utilization products; low research; expanse of potential beneficiary and distance from source investment

Recommendations for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity; Adoption studies; Conduct variety awareness and preference socioeconomic study.
Lessons learned	Not yet disseminated but anticipated - Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Production cost data yet to be estimated
Estimated returns	Estimated Production returns data yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up.	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them;</li> <li>• Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity and thus need for mechanization/ labor saving interventions;</li> <li>• Markets for increased production</li> </ul>
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	The variety is still in research Centers – at Kakamega and Kisii
Application guidelines for users	Finger millet variety production leaflet
<b>F: Contacts</b>	
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	Centre Director KALRO – FCRI Kisii P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel.

	+254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Busia, Kakamega, Bungoma, and Siaya.

### Variety KACIMMI 65 Gaps

1. Needs testing through NPT and DUS for release and seed multiplication
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs extensive on-farm testing and validation

TIMP Name	Finger Millet Variety GBK 043254
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Low yields due to late crop maturity in mid to low rainfall areas; - Few market options attributed to low utilization (consumption, processing, trade, manufacturing etc.)
What is it? (TIMP description)	A high yielding, early maturing, finger millet variety that is –; Striga resistant, Blast and Drought tolerant; Characteristic features include; Whitish Brown grain color; light purple pigmentation; medium height; medium size open panicles with finger spikelet discontinuity. Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2,000 m.a.s.l.) and soils (well-draining loams). <b>Features:</b> Whitish brown grain color; no pigmentation; medium height; medium size open panicles with gapy spikes.
Justification	-Variety is already in National Performance Trials and has potential for release to serve short rain season areas in Kenya; This very high yielding variety with wide adaptability will address poor yields in the mid to low rainfall areas.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	Not yet disseminated but methods used in successfully disseminating earlier technologies to be adopted i.e. On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks

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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Variety still in research Centers – Kakamega and Kisii.
Counties where TIMPS will be upscaled	Bomet, Kericho and West Pokot
Challenges in development and dissemination	Not yet disseminated but expected challenges - Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line-self-pollinating crops; limited utilization products; low research investment; expanse of potential beneficiary and distance from source.
Recommendations for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity; ex-ante adoption and impact assessment studies; Conduct variety preference study along the value chain.
Lessons learned	Not yet disseminated but anticipated - Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Production cost data yet to be estimated
Estimated returns	Estimated Production returns data yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Labor intensity in weeding, threshing and winnowing – mostly done by women; Grain sales also by women– mostly done by women; therefore, likely to overburden them but also benefit them as most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> </ul>

	<ul style="list-style-type: none"> <li>Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	The variety is still in research Centers – at Kakamega and Kisii
Application guidelines for users	Finger millet variety production leaflet
<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	Centre Director KALRO – FCRI Kisii P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Busia, Kakamega, Bungoma, and Siaya.

### Variety GBK 043254 Gaps

- Needs testing through NPT and DUS for release and seed multiplication
- Needs improvement in yield and resistance to biotic and abiotic stresses
- Needs extensive on-farm testing and validation

<b>TIMP Name</b>	<b>Finger Millet Variety KACIMMI 49</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low finger millet yields
What is it? (TIMP description)	<p>A high yielding, medium maturing finger millet variety –that is also Striga, blast and drought tolerant.</p> <p>Characteristic features include: Brown grain color; no pigmentation; medium height; medium size twisted finger panicles.</p> <p>Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 2,000 m.a.s.l.) and soils (well-draining loams).</p>
Justification	-Variety is very high yielding with wide adaptability. It is already in National Performance Trials and has potential for release to serve medium rain season areas in Kenya;

Counties where TIMP will be upscaled	Kericho, Bomet, and West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	Not yet disseminated but methods used in successfully disseminating earlier technologies to be adopted i.e. 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 capacity building, Functioning seed system, Stakeholder networks
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Not yet promoted but can grow well in all regions varying in yield depending on climatic conditions. Variety still in research Centers – Kakamega and Kisii.
Counties where TIMPs will be upscaled	Bomet, Kericho and West Pokot
Challenges in development and dissemination	Not yet disseminated but expected challenges - Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line self-pollinating crops; limited utilization products; low research investment expanse of potential beneficiary and distance from source.
Recommendations for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews; positive publicity; ex-ante adoption and impact assessment studies; Conduct variety preference study along the value chain.
Lessons learned	Not yet disseminated but anticipated - Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and</b>	Requires validation

<b>marginalized groups (VMGs) considerations</b>	
Basic costs	Production cost data yet to be estimated
Estimated returns	Estimated Production returns data yet to be calculated
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women;</li> <li>• Grain sale also by women– mostly done by women; therefore, likely to overburden them but also benefit them as most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	Increased production will lead to improved food and nutrition security among VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	The variety is still in research Centers – at Kakamega and Kisii
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO – FCRI Kisii P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Busia, Kakamega, Bungoma, and Siaya.

#### **Variety GBK KACIMMI 49 Gaps**

1. Needs testing through NPT and DUS for release and seed multiplication
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs extensive on-farm testing and validation


<b>TIMP Name</b>	<b>Finger Millet Variety Nakuru 1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low finger millet yield and production
What is it? (TIMP description)	A high yielding (1,200 - 3,500kg/ha <sup>-1</sup> , depending on environment), late maturing (120 – 210 days) finger millet variety. It is tolerant to cold and drought. Its characteristic features include dark brown grain color, purple pigmentation and medium size open panicles. Optimal environmental conditions: Rainfall (600-900mm annually), altitude (1750 – 2500 m.a.s.l.) and soils (well-draining loams). Adapted to cold dry highlands.
Justification	-The variety was released in 1996 for production in the cool dry highlands of Kenya thus diversifying areas of finger millet production.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
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 capacity building, Functioning seed system, Stakeholder networks and effective extension system.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Nakuru and Baringo Counties
Counties where TIMPs will be upscaled	Bomet, Kericho and West Pokot
Challenges in development and dissemination	Not yet extensively disseminated. Expected challenges include; Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; seed companies disinterest in pure-line self-pollinating crops; limited utilization of products and low research investment.

Recommendations for addressing the challenges	Investment in crop development (research, extension, processing and manufacturing); supportive policies like the recently passed blending policy, lifting of ban on traditional brews and positive publicity; ex-ante adoption and impact assessment studies; Conduct variety preference study along the value chain.
Lessons learned	Not yet disseminated but anticipated - Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Production cost = 30,250/=
Estimated returns	Estimated Production returns = 60,606/=, thus estimated net returns = 30,356/=
Gender issues and concerns in development and dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women; therefore, likely to overburden them;</li> <li>• Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women's livelihood.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women's crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value of crop will lead to economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The variety is still in research Centers – at KALRO BRC Lanet
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up scaling

<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Lanet P.O. Box 3840, NAKURU; e-mail address: <a href="mailto:kalrolanet@gmail.com">kalrolanet@gmail.com</a> ; Tel. +254 (0) 0722 639419
Lead organization and scientists	KALRO, Peter Gachuki
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Nakuru

**Variety Nakuru FM-1 Gaps**

1. Needs diversification in adaptability for production in wider agro-ecological zones
2. Needs improvement in yield and resistance to biotic and abiotic stresses

<b>TIMP Name</b>	<b>Finger Millet Variety KAT FM 1</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Late maturity in low moisture areas and low finger millet yield.
What is it? (TIMP description)	<p>It is an early maturing (80 – 115 days); Drought tolerant; moderate yield (1,000 – 2,500kg ha<sup>-1</sup>) finger millet variety –also suitable for production at altitudes ranging from 250 – 1,150 m.a.s.l.</p> <p><b>Features:</b> Brown grain color; no pigmentation; medium height; high tillering; robust growth; open panicles; prominent grain. Optimal environmental conditions: Rainfall (400-700mm annually), altitude (0 – 1200 m.a.s.l.) and soils (well-draining loams).</p>
	
Justification	-Early maturing variety released in 2000 to serve low rain, low altitude areas in Kenya, especially eastern Kenya.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches 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 capacity building, Functioning seed system, Stakeholder networks
Partners/stakeholders for scaling up, their respective roles and stage of involvement.	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Eastern Kenya but has been disseminated to wetter areas with disastrous results – blast infestation and damage – Seed at KALRO Katumani and Kenya Seed Company.
Counties where TIMPs will be upscaled	Drier areas of Kericho and West Pokot
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> </ul>

	<ul style="list-style-type: none"> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure line self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research; expanse of potential beneficiary and distance from source.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> <li>• Supportive policies like the recently passed blending policy, lifting of ban on traditional brews;</li> <li>• Positive publicity;</li> <li>• Ex-ante adoption and impact assessment studies;</li> <li>• Conduct variety preference study along the value chain; economic analysis.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya;</li> <li>• Stakeholder linkages and participatory implementation is important.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders;</li> <li>• Understanding the physical and biotic environment in target ecologies;</li> <li>• Understanding community culture, preferences, and practices</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Cost of Production per acre: 30,250/=
Estimated returns	Estimated Production returns per acre: 48,485 and thus net returns = 18,235/=
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing – mostly done by women;</li> <li>• Grain sale also by women– mostly done by women; therefore, likely to overburden them thus, increased production and marketing likely to improve the women’s livelihood as most of the sales cash is retained by them.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men; women do not travel far to communicate message; hence, could limit up-scaling.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> </ul>

	<ul style="list-style-type: none"> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value of crop will lead to economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The variety success not conspicuous
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO – FCRI Kisii P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/+254 (0) 771437985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori, and Ms. Rachel Kisilu
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – Machakos, Makueni, Kitui, Tharaka Nithi, Embu, and Meru.

### Variety KAT FM 1 Gaps

1. Needs improvement in blast disease resistance
2. Needs improvement in yield and resistance to biotic and abiotic stresses
3. Needs improvement in lodging resistance

<b>TIMP Name</b>	<b>Finger Millet Variety MSU FM 60D</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Low finger millet yield and low rainfall conditions.
What is it? (TIMP description)	An early maturing (80-90 days) finger millet variety with moderate yield (average 3,120kg/ha <sup>-1</sup> ). Characteristic features include brown grain color with no anthocyanins (purple colouration) on leaves, nodes, and panicles., It also has large open panicles with prominent grains; it is prone to post maturity lodging, moderately susceptible to blast disease.  Optimal environmental conditions: Rainfall (600-900mm annually), altitude (0 – 1500 m.a.s.l.) and soils (well-draining loams).
Justification	-Released in 2016 for moisture stress areas for drought tolerance and escape. Because of early maturity, it is drought escaping and thus assurance of produce. As a cereal, it provides food diversity and

	security e.g. unlike maize, it is not affected by maize lethal necrosis and Fall Army Worm
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches 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 capacity building, Functioning seed system, Stakeholder networks and efficient extension service.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Not yet extensively disseminated.
Counties where TIMPs will be up scaled	Drier areas of Kericho and West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop; limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research investment.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> <li>• Supportive policies like the recently passed blending policy, lifting of ban on traditional brews;</li> <li>• Positive publicity ex-ante adoption and impact assessment studies;</li> <li>• Conduct variety preference study along the value chain; economic analysis.</li> </ul>
Lessons learned in up-scaling if any?	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders;</li> <li>• Understanding the physical and biotic environment in target ecologies;</li> </ul>

	<ul style="list-style-type: none"> <li>Understanding community culture, consumer preferences and social practices.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 55,000/= and thus net benefit KES 22,250/=
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Labor intensity in weeding, threshing and winnowing – mostly done by women;</li> <li>Grain sale also by women– mostly done by women; therefore, likely to overburden them but also benefit them since most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood.</li> <li>Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men; women do not travel far to communicate message; hence, could limit up-scaling.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Enhance women training for improved performance</li> <li>Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>High value of crop will lead to economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Not yet disseminated.
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up scaling.
<b>G: Contacts</b>	
Contacts	Maseno University, P.O. Box 333 Maseno, <a href="mailto:vc@maseno.ac.ke">vc@maseno.ac.ke</a> OR <a href="mailto:mitodida@yahoo.com">mitodida@yahoo.com</a> ; Tel. +254 (0) 711 860550.
Lead organization and scientists	Maseno University; Prof. Mathews Dida
Partner organizations	KALRO; ICRISAT Nairobi; MoALF&I in Counties – Busia, Kakamega, Bungoma, and Siaya, Bomet, Kericho, West Pokot.

<b>TIMP Name</b>	<b>Finger Millet Variety EUFM-401</b>
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Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>• Low finger millet productivity due to unsuitable varieties and low rainfall conditions.</li> </ul>
What is it? (TIMP description)	<p>A very early maturing (65-75 days) finger millet variety with moderate yield (1,000 – 1,400kg/ha<sup>-1</sup>) in Arid and Semi-Arid Lands. Characteristic features include heat tolerance.</p> <p>Optimal environmental conditions: Rainfall (400-600mm annually), altitude (&lt;1500 m.a.s.l.) and soils (well-draining loams).</p>
Justification	-Released in 2016 for moisture stress areas for drought tolerance and escape. Because of early maturity, it is drought escaping and thus assurance of produce making it a good choice crop for food and nutrition security and farmer resilience.
Counties where TIMP will be promoted	Bomet, Kericho and West Pokot and dryland areas where finger millet is produced.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks and efficient extension service.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Current extent of reach	Not yet extensively disseminated.
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research investment.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> </ul>

	<ul style="list-style-type: none"> <li>• Supportive policies like the recently passed blending policy, lifting of ban on traditional brews;</li> <li>• Positive publicity.</li> </ul>
Lessons learned in up-scaling if any?	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders;</li> <li>• Understanding the physical and biotic environment in target ecologies;</li> <li>• Understanding community culture and social practices;</li> <li>• Ex-ante adoption and impact assessment studies;</li> <li>• Conduct variety preference study along the value chain..</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/= Actual economic analysis yet to be conducted
Estimated returns	Per acre returns KES 40,000/= and thus net benefit KES 9,750/=
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing (variety has poor thresh ability and dusty thus aggravating labor intensity) – mostly done by women;</li> <li>• Grain sale also by women; therefore, likely to overburden them;</li> <li>• Increased production and marketing likely to improve the women's livelihood as most of the cash retained by them;</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;</li> <li>• Women do not travel far to communicate message; hence, could limit up-scaling</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women's crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value of crop will lead to economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Not yet disseminated.
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for</b>	Ready for up scaling.

<b>up-scaling; 2. Requires validation; 3. Requires further research)</b>	
<b>G: Contacts</b>	
Contacts	Egerton University: Division of Research and Extension; P.O. Box 536 Egerton, email: dvc@egerton.ac.ke, Tel. +254 (0) 725 309162.
Lead organization and scientists	Egerton University; Prof. Paul Kimurto
Partner organizations	KALRO; ICRISAT Nairobi; MoALF&I in dryland areas of –Bomet, Kericho, West Pokot, Baringo, Turkana, Machakos, Kitui, Tharaka Nithi Counties etc.

<b>TIMP Name</b>	<b>Finger Millet Variety EUFM-502</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Low finger millet yields due to low rainfall.
What is it? (TIMP description)	A medium maturing (100-120 days) finger millet variety with moderate yield (1,400 – 2,000kg/ha <sup>-1</sup> ). Characteristic features include high tillering capacity that can provide fodder.  Optimal environmental conditions: Rainfall (500-700mm annually), altitude (1,200 – 2,200 m.a.s.l.) and soils (well-draining loams).
Justification	-Released in 2018 for medium moisture mid-altitude conditions. Because of early maturity, low moisture requirement and high tillering capacity it is a good choice crop for food and nutrition security and farmer resilience.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches 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 capacity building, Functioning seed system, Stakeholder networks and efficient extension service.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	

Counties where already promoted if any	Not yet extensively disseminated.
Counties where TIMPs will be up scaled	Bomet, Kericho and West Pokot mid –altitude moderate rainfall areas where finger millet is produced.
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research investment.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> <li>• Supportive policies like the recently passed blending policy, lifting of ban on traditional brews;</li> <li>• Positive publicity ex-ante adoption and impact assessment studies;</li> <li>• Conduct variety preference study along the value chain; economic analysis;</li> <li>• Social and cultural acceptability.</li> </ul>
Lessons learned in up-scaling if any?	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Gender inclusiveness in crop research and development;</li> <li>• Capacity building of stakeholders;</li> <li>• Understanding the physical and biotic environment in target ecologies;</li> <li>• Understanding community culture, consumer preferences and social practices.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=
Estimated returns	Per acre returns KES 40,000/= and thus net benefit KES 10,962/=
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Labor intensity in weeding, threshing and winnowing (variety has poor thresh ability and dusty thus aggravating labor intensity) – mostly done by women;</li> <li>• Grain sale also by women; therefore, likely to overburden them; increased production and marketing likely to improve the women’s livelihood since most of the cash retained by them.</li> <li>• Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men;</li> <li>• Women do not travel far to communicate message; hence, could limit up-scaling.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>

VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions;</li> <li>• Markets for increased production</li> </ul>
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	Not yet disseminated
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up scaling.
<b>G: Contacts</b>	
Contacts	Egerton University: Division of Research and Extension; P.O. Box 536 Egerton, email: dvc@egerton.ac.ke, Tel. +254 (0) 725 309162.
Lead organization and scientists	Egerton University; Prof. Paul Kimurto
Partner organizations	KALRO; ICRISAT Nairobi; MoALF&I in Bomet, Kericho, West Pokot, Baringo, Machakos, Kitui, Tharaka Nithi Counties etc.

<b>TIMP Name</b>	<b>Finger Millet Variety EUFM-503</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Low finger millet yields due to low rainfall.
What is it? (TIMP description)	<p>A medium maturing (90-98 days) finger millet variety and moderate yield (1,500 – 2,500kg/ha<sup>-1</sup>). Characteristic features include long multi-fingered panicles, high tillering capacity, resistant to blast.</p> <p>Optimal environmental condition: Rainfall (500-700mm annually), altitude (1,200 – 2,200 m.a.s.l.) and soils (well-draining loams).</p>
Justification	-Released in 2018 for medium moisture mid-altitude conditions. Due to its early maturity, low moisture requirement and high tillering capacity it is a good choice crop for food and nutrition security and farmer resilience.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks and efficient extension service.
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	
Counties where already promoted if any	Not yet extensively disseminated.
Counties where TIMPs will be upscaled	Bomet, Kericho and West Pokot mid –altitude moderate rainfall areas where finger millet is produced.
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Negative attitude to crop in some segments of society (orphan crop);</li> <li>• Limited investment in crop;</li> <li>• Limited publicity;</li> <li>• Seed companies disinterest in pure-line-self-pollinating crops;</li> <li>• Limited utilization products;</li> <li>• Low research investment.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Investment in crop development (research, extension, processing and manufacturing);</li> <li>• Supportive policies like the recently passed blending policy,</li> <li>• Lifting of ban on traditional brews;</li> <li>• Positive publicity.</li> </ul>
Lessons learned in up-scaling if any?	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; Capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, consumer preferences and social practices.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Per acre production cost KES 30,250/=

Estimated returns	Per acre returns KES 40,000/= and thus net benefit KES 18,235/=
Gender issues and concerns in development, dissemination adoption and scaling up	Labor intensity in weeding, threshing and winnowing (variety has poor threshability and dusty thus aggravating labor intensity) – mostly done by women; Grain sale also by women; therefore, is likely to overburden them; Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men; women do not travel far to communicate message; hence, could limit up-scaling
Gender related opportunities	<ul style="list-style-type: none"> <li>• Enhance women training for improved performance</li> <li>• Increased incomes for Women from increased grain sales (this is considered largely as a women’s crop).</li> <li>• Youth also stand to benefit through application of ICT networking for marketing.</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.</li> <li>• Labor intensity and thus need for mechanization/ labor saving interventions; markets for increased production</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs;</li> <li>• High value of crop will lead to economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Not yet disseminated
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up scaling.
<b>G: Contacts</b>	
Contacts	Egerton University: Division of Research and Extension; P.O. Box 536 Egerton, email: dvc@egerton.ac.ke, Tel. +254 (0) 725 309162.
Lead organization and scientists	Egerton University; Prof. Paul Kimurto
Partner organizations	KALRO; ICRISAT Nairobi; MoALF&I in dryland areas of Bomet, Kericho, West Pokot, Baringo, Turkana, Machakos, Kitui, Tharaka Nithi Counties.

## 2.2 Good Agricultural Practices (Gaps) And Food Safety Management Systems

2.2.1. TIMPs name	Good Agricultural Practices (GAP) for Finger Millet
Category (i.e. technology, Innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Noncompliance of regulation and policies that are put in place to enable production and consumption of quality and safe food/farm produce has led to declining food safety. Reduced food quality. Knowledge on Sustainable farming practices that will ensure reduced negative environmental impact, worker safety and health is required in addition to enhanced traceability process. Excessive pesticides application to crops using wrong application techniques are some of the areas raising a lot of concern within the production system
What is it? (TIMP description)	<p>The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely.</p> <p>It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards.</p> <p>It is not about a specific crop production but the process through which production takes.</p>
Justification	Good Agricultural Practice (GAP) is based on the principles of risk prevention, risk analysis, sustainable agriculture (by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table
	but also upstream to include suppliers (e.g. fertilizers, plant protection) and all value chain players including providers of logistics and farm equipment
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	All Cabbage value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support from government
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MoA, Private extension providers, CoG and other value chain players

<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Busia, Taita Taveta, Makueni, Meru, Uasin Gishu, Marakwet, Trans Nzoia, Bungoma, Busia, Kakamega, Vihiga, Kisumu, Kisii, Siaya
Counties where TIMP will be upscaled	All counties in Kenya where Cabbage is produced and Consumed
Challenges in dissemination	Lack/inadequate knowledge on the benefits GAPs Lack of legislative mechanisms to support the GAP, in particular the domestic scope The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if Any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
<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	Women and youth have limited access to land for cabbage cultivation than men Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. Women and youth may have limited access to farm inputs than men The technology may not be adopted if the gender targeted is women who are especially overburdened
	Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Proper application of GAP will led to improved health of the various gender categories such as women All gender categories can participate in growing cabbage varieties Use of the farmer field and business school strategy for effective training of farmer groups on cabbage production and marketing Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. Opportunities for youths and women exists in cabbage production and marketing

VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs are not given equal chances of attending the GAP trainings opportunities VMGs may also have limited access to finances to buy the different required inputs that ensures production of quality and safe foods along the cabbage value chain VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	Affirmative action in various areas as for instance in the provision of finances to VMGs Increased awareness creation will increase production of quality and safe food along cabbage value chain. This will lead to increased consumption and utilization of quality and safe cabbages and hence improved health of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Options for certification exist depending on whether it is a single holder certification or group compliance. Compliance is a process and hence takes time and involves a process of continuous improvement. No need for farm sophistication to adopt. There is provision for taking corrective action for all noncompliance at time of assessment.
	Requires continuous training and exposure to better systems.
<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	Officer in Charge KALRO – PTC, Centre Directors; KALRO FCRI Njoro; Director General KALRO.
Lead organization and scientists	KALRO, E. Mutuma; J. Wamunongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations and their roles	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

<b>2.2.2. TIMP Name</b>	<b>Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Cabbage Value Chain in Kenya</b>
Category (i.e. technology, innovation or management)	Management Practice

practice)	
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<p>The presence of chemical, biological and physical hazards in the cabbage value chain in Kenya have a direct effect on consumer's health thereby constantly increasing demand for high quality of the crop and it's by products from consumers and public health departments in counties. These hazards have direct economic consequences affecting families, communities and industries subsisting on the cabbage value chain in Kenya. This ultimately leadsto reduced productivity of the active population in the country. The biological contaminations previously reported on this value chain include presence of <i>Escherichia coli</i> (E. coli), <i>Salmonella</i> spp., <i>Shingella</i> spp., and <i>Staphylococcus aureus</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 Cabbage value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the Cabbage supply from biological, chemical and physical hazards into the hands of food management systems. This HACCP system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls. When this HACCP concept is applied to the management of likely adverse health effects resulting from exposure to hazards in the Cabbage value chain a wholesome and safe Cabbage value chain can be maintained improving on trade and health within and without Kenya borders.</p>
Justification	<p>The only important tool kit to assure food safety through monitoring in the Cabbage value chain is the Hazard Analysis and Critical Control Points (HACCP) system. This critical tool is already incorporated into the Codex Alimentarius of the world as well as into the national public health food safety legislations of Kenya. The HACCP approach can be applied to all stages of the Cabbage value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the Cabbage value chain will easily be identified through critical control points. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range required. In this Cabbage value chain, the proposed FSMS that will be adopted, different hazards would</p>


	be minimized in every phase of production, harvesting, processing, distribution and consumption making Cabbage safe for consumption by Kenyans. Key elements will be identified that will be used or modified to reduce hazards formation in all steps of production to consumption.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Finger millet value chain actors from farmers, traders, food vendors, food processors and consumers
Approaches used in dissemination	The entire Cabbage value chain will be evaluated by determining contamination hazards in primary production systems and available control methods. The information will be disseminated using Farmertrainings, farmer field schools, shows, trade fairs, Plant clinics, common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, and Twitter).
Critical/essential factors for successful promotion	For successful promotion of food safety management system through HACCP in the Cabbage value chain; An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the cabbage growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards will be formulated. Distribution of the printed HACCP plan to Cabbage value chain actors for implementation in order to reduce hazards.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>• Institutions with IPM and ICM programs</li> <li>• Institutions responsible for legislating in food safety, regulations and sale of pesticides</li> <li>• Institutions with the required analytical testing</li> <li>• Training institutions with extension programs to producers and other actors on the chain</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	Busia, Taita Taveta, Makueni, Meru, Uasin Gishu, Marakwet, Trans Nzoia, Bungoma, Busia, Kakamega, Vihiga, Kisumu, Kisii, Siaya
Counties where TIMPs will be upscaled	All counties growing and consuming Finger millet in Kenya.
Challenges in development and dissemination	Inadequate funds to reach value chain actors
Suggestions for addressing	Funding of dissemination platforms

the challenges	
Lessons learned in up scaling, if any	The value chain of cabbage in Kenya is willing to adopt the HACCP plan if well engaged.
Social, environmental, policy and market conditions necessary for development and up-scaling	The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in cabbage value chain.
<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 cabbage 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>• The technology may not be adopted if the gender targeted is women who are especially overburdened</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 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 such as women</li> <li>• All gender categories can participate in growing cabbage varieties</li> <li>• Use of the farmer field and business school strategy for effective training of farmer groups on cabbage production and marketing</li> <li>• Cash generated from cabbage production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming.</li> <li>• Opportunities for youths and women exist in cabbage production and marketing</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 limited access to land for cabbage cultivation than men</li> <li>• VMGs may have less access to credit</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</li> </ul>

	materials
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in the provision of finances to VMGs</li> <li>• Increased production will lead to increased consumption and utilization of cabbage s hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	N/A
Application guidelines for Users	N/A
<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>	
Lead Organization and scientists	<p>Institute Director, Horticulture Research Institute (HRI) P.O. Box 220 01000 Thika Email: CD.HRI @kalro.org Phone: 0722436544, Thika</p> <p>Institute Director, Food Crops Research Institute (FCRI) P.O. Box 450-3200 Kitale, Email: Director.fcric@kalro.org Phone: +254- 2029632, Kitale.</p> <p>KALRO scientists: Esilaba A.O., Odhiambo H., Otipa M. J., Masinde A. A.O., Ndungu B. W., Muriuki S. K., Ochieng V., Nasirembe W.,Ndubi J., Ndambuki, J.</p>
<b>Partner organizations</b>	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities

### 2.3 Agronomic Practices for Finger Millet

<b>2.3.1. TIMP Name</b>	<b>Planting Finger Millet in rows</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High labor intensity requirements in finger millet cultivation leading to high production costs, eroding incomes.


<p>What is it? (TIMP description)</p> 	<p>Planting finger millet in rows spaced at 30x15cm inter and intra-row spacing, respectively. Planting is done by making furrows at the specified spacing, then drilling in fertilizer, before drilling in seed and covering the furrows. The intra row spacing is attained by thinning the crop in a row to specified spacing. This is in contrast to the old farmers practice of broadcasting that leads to cumbersome weeding</p>
<p>Justification</p>	<p>-Weeding is one of the labor intensive operations in finger millet cultivation and planting in rows will make weeding easier and also enhance cost effective application of fertilizer. Planting in rows also makes monitoring and management of diseases easier and more effective</p>
<p>Counties where TIMP will be up-scaled</p>	<p>Kericho, Bomet, and West Pokot</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers and extension agencies</p>
<p>Approaches used in dissemination</p>	<p>On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.</p>
<p>Most effective approach</p>	<p>On-farm experimentation and larger plot effect demonstrations.</p>
<p>Critical/essential factors for successful promotion</p>	<p>Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks</p>
<p>Partners/stakeholders for scaling up and their respective roles</p>	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted if any</p>	<p>Has been promoted in western Kenya with an adoption rate of 68% among finger millet farmers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.</p>
<p>Counties where TIMPs will be upscaled</p>	<p>Bomet, Kericho and West Pokot</p>

Challenges in dissemination	Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; low research.
Recommendations for addressing the challenges	Investment in crop development (research and extension, positive publicity on the nutritive benefits and resilience capacity of the crop; participatory comparative economic analysis to highlight the benefits
Lessons learned	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary	Women main players in finger millet cultivation and row planting will ease women labor and capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet calculated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Labor intensity in weeding, threshing and winnowing – mostly done by women; Grain sale also mostly done by women; therefore likely to overburden them; since most of the cash retained by them, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the opinion and interests of men; women do not travel far to communicate message; hence, could limit up-scaling.
Gender related opportunities	The whole household stands to gain from improved production and incomes
VMG issues and concerns in development, dissemination adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in	Reduced labor requirements will lead to ease of production, a benefit to VMGs.
VMG related opportunities	Increased production will lead to improved food and nutrition security to the advantage of VMGs within the households. Improved production may also lead to improved incomes for VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	In western Kenya almost every other finger millet farm is planted in rows.
Application guidelines for users	Finger millet variety production leaflet
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling

<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ +254 (0) 771 437 985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties

### **Gaps in Finger Millet Row Planting**

1. Labor intensity – need to develop seed drill machine
2. Need to validate optimum plant population and planting arrangement

<b>2.3.2 TIMP Name</b>	<b>Fertilizer in Finger Millet cultivation</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 productivity due to inadequate soil nutrient levels
What is it? (TIMP description)	The application of fertilizer for yield optimization in finger millet cultivation rate of 100kg ha <sup>-1</sup> 20:20:0 NPK at planting and 100kg ha <sup>-1</sup> CAN at top-dressing
	
Justification	-Finger millet yields are low due to inadequate soil nutrient levels arising from continuous cultivation. Improved finger millet varieties need fertilizer in order to realize their full yield potential. Fertilizer application contributes to significant yield increase and can even lead to 100% yield increase.
Counties where TIMP will be upscaled	Bomet, Kericho, and West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
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>• ICRISAT for technical backstopping and promotion;</li> </ul>

	<ul style="list-style-type: none"> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	This has been promoted in western Kenya in Kakamega, Busia, Bungoma, and Siaya Counties with an adoption rate of 50% of finger millet farmers now using fertilizer on finger millet.
Counties where TIMPs will be upscaled	All other counties with suitable agro-ecological settings suitable for Finger millet production.
Challenges in dissemination	Negative attitude to crop in some segments of society (orphan crop); high cost of fertilizer, wrong belief that finger millet can do without fertilizer; limited investment in crop; limited publicity; low research.
Recommendations for addressing the challenges	Training of farmers on the value of fertilizer in finger millet; Investment in crop development (research and extension), positive publicity.
Lessons learned	Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in western Kenya; stakeholder linkages and participatory implementation is important. Demonstration of the effect of fertilizer can spur adoption of finger millet.
Social, environmental, policy and market conditions necessary	Understanding the attitude of community towards fertilizer use; carrying out soil analysis and surveys to understand fertilizer requirements. Sensitization of stakeholders and policy makers on the value of fertilizer on the crop.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	About KES 5,000/= per acre i.e. 1x50kg each of planting and top dressing fertilizer
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Labor intensity in weeding, threshing and winnowing – mostly done by women; Grain sale also by women– mostly done by women; therefore, likely to overburden them; Grain sold by women and most of the cash retained by them; thus, increased production and marketing likely to improve the women’s livelihood. Most farmer groups composed of women – if targeted this may leave out the

	opinion and interests of men; women do not travel far to communicate message; hence, could limit up-scaling.
Gender related opportunities	Women stand to benefit from increased production and grain sales as this is considered a women crop.
VMG issues and concerns in development, dissemination adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in	Labor intensity reduction will lead to easier production by VMGs.
VMG related opportunities	Increased production will lead to improved food and nutrition security to the advantage of VMGs within the households. Improved production will also lead to improved incomes for VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	In western Kenya, before intervention only 5.5% of the households in 2007, used fertilizer on finger millet, In 2015, an impact study in the area showed that on average, 49.9%, and 76.6% of households in the area and project farmers, were using fertilizer on finger millet, respectively.
Application guidelines for users	Finger millet variety production leaflet Basal fertilizer, preferably compound 20:20:0 is applied uniformly by drilling in furrows at a rate of 20Kgha-1 each of N and P2O5 before applying seed by drilling and covering the furrows with loose soil. This is about applying 2 x 50 bags of fertilizer per hectare. Then after thinning of the crop, another 2x50kg bags of CAN fertilizer is applied as a top dress.
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ +254 (0) 771 437 985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties

### Gaps in Fertilizer Use on Finger Millet

1. Refinement in fertilizer levels and fertilizer options
2. Need to determine appropriate strategy of fertilizer application, especially for dry planting

<b>2.3.3 TIMP Name</b>	<b>Timely/Early Planting of Finger Millet</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 and or crop failure due to early dry planting or late planting. Recommendation – planting at onset of rains in the season assures utilization of precipitation available in the season
What is it? (TIMP description)	The practice of planting finger millet at the appropriate time in relation to the onset of the rains e.g. in western Kenya by the 15 <sup>th</sup> March during the long rains.
Justification	Dry planting before on-set of rains necessitates planting without fertilizer to avoid scorching which reduces yield. On the other hand, late planting especially in semi-arid areas often results in crop failure due to lack of moisture at the crucial stages of crop growth. Timely planting at onset of rains enables use of fertilizer and full utilization of the season's rainfall and avoidance of pests and diseases build-up.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be upscaled	All other counties with suitable agro-ecological settings for finger millet production
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
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>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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>	

Current extent of reach	Finger millet farmers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya appreciate the need to plant early.
Challenges in dissemination	Unpredictability of onset of seasonal rains; Negative attitude to crop in some segments of society (orphan crop); limited investment in crop; limited publicity; low research.
Recommendations for addressing the challenges	Liaise with the Meteorological Department to get accurate predictions. Training of farmers on the value of access to and use of meteorological data; Investment in crop development (research and extension), positive publicity.
Lessons learned	Access to and use of meteorological forecasts can enhance planting on time and thus enhance yield.
Social, environmental, policy and market conditions necessary	Sensitization of communities on seasons and use of meteorological data.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	None
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Need to sensitize both men and women on value of meteorological data in agriculture.
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	Men are the custodian of family resources and have to be convinced on the advantages of adopting GAP. Women, however who carry out the production and sales activities stand to gain from the resulting increased production. Most farmer groups comprise women and will enhance women technology uptake but leave out the opinion and interests of men;
Gender related opportunities	Women stand to benefit in increased production due to timely operations and grain sales as this is considered a women crop.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Timely operations will lead to enhanced production by VMGs.
VMG related opportunities	Increased production will lead to increased consumption of nutritious finger millet, hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	In western Kenya where almost every other finger millet farmer plants early, some even doing dry planting before onset of rains.
Application guidelines for users	Finger millet variety production leaflet
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires	Ready for up-scaling

validation; 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/+254 (0) 736 220 821/ +254 (0) 771 437 985
Lead organization and scientists	KALRO, Dr. Chrispus O.A. Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties

### Gaps in Finger Millet Timely Planting

1. Needs review and adaptation to climate change effects
2. Needs validation in various environments of finger millet cultivation

### 2.4 Soil Fertility Management

<b>2.4.1 TIMP name</b>	<b>Integrated Manure Management (IMM)</b>
Category (i.e. technology, innovation or management practice)	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 poor soil health Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops.
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 by smallholder farmers, 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	Farmers
Approaches used in dissemination	Open and field days, Exchange visits and Demonstration farms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Training on feeding, management and use of manure</li> <li>• Dissemination approach used to reach target farmers</li> <li>• Model demonstration plots using cereal crops</li> </ul>
Partners/stakeholders for scaling up and their roles	County governments, to provide extension services, farmer mobilization and policy formulation

	ILRI to provide technical backstopping NGOs, to provide micro financing services
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kakamega, Buisa, Bungoma, Siaya
Counties where TIMP will be promoted	Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of model demonstration farms</li> <li>• Lack of continuity in training of extension and farmers in the skill for manure management</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 plot by counties</li> <li>• Capacity building of finger millet farmers on manure management and its benefits.</li> <li>• Continuous capacity building of finger millet farmers and extension workers through field demonstrations.</li> <li>• Mobilization of finger millet farmers to attend demonstration forums.</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>• Proper use of manure improves soil fertility</li> <li>• Use of manure enhances crop yields</li> <li>• Skills in manure preparation, storage and application contribute to effective utilization of manure for crop production.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water.</li> <li>• Propagation of invasive weed species when the seed is ingested by the animal and passed to crop field.</li> <li>• Manure can harbor pathogens which can cause disease outbreaks to livestock</li> <li>• Contamination of water sources by leaching of nutrients</li> <li>• When poorly handled, manure increases GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Proper handling of manure needs labor for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time</li> <li>• Using locally available manure/compost saves on purchase of inorganic fertilizer.</li> </ul>
Estimated returns	Returns dependent on finger millet varieties where IMM is practiced

Gender issues and concerns in development, dissemination, adoption and scaling up	It is labor intensive in terms of handling and application (often by broadcasting) hence may disadvantage women
Gender related opportunities	Manure is locally available for farm households with livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labor intensive in terms of handling and application hence may disadvantage VMGs. The VMGs are also resource poor, hence may not have access adequate manures, e.g. need many livestock
VMG related opportunities	Manure is locally available for those farm households with livestock and can build on what they already own
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers who adopt Integrated Manure Management practices have reported improved soil health and 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>• Routine manure collection</li> <li>• Storage of manure under partial shade to preserve nutrients while enhancing decomposition.</li> <li>• Manure treatment for ease of transport and application in the field</li> <li>• Timely manure 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/Compost takes 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
Lead organization and scientists	KALRO S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations	County government, Private Public Partnerships

### Research gaps

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

Conduct nutrient budget study on selected farms utilizing manures (including composts) in each of the finger millet growing counties.

<b>2.4.2. 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	Declining soil fertility, low organic matter, degraded soil structure poor soil moisture conservation in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed combined to adapt practices to local conditions. It places emphasis on the importance of using 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	Past soil management practices have major influences on soil fertility which in turn influences productivity. Integrated Soil Fertility Management (ISFM) approach 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	Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Training workshops</li> <li>• On-farm visits</li> <li>• Farmer Field Schools (FFS)</li> <li>• On-farm demonstrations (during FFS)</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>• Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and</li> <li>• Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.</li> </ul>
Partners/stakeholders for scaling up and their roles	County government extension services to link farmers with relevant stakeholders. Community farmer groups to play a coordination role for ease of problem identification and dissemination.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kakamega, Buisa, Bungoma, Siaya,

Counties where TIMP will be promoted	Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Fixed mindset in some regions/cultures that organic manures cannot be applied on crops</li> <li>• Misconceptions that application of chemical fertilizers damage the soils.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness trainings on the role of organic manure 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, clean and viable germplasm/seed/seedlings, etc is required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <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	This is a technically demanding technology and high cost in areas where application of ISFM is non-responsive
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50%
Gender issues and concerns in development, dissemination adoption and scaling up	<p>The practice integrates participation of male and female gender roles during field activities. Female gender is disadvantaged where application of heavy loads of manure are to be incorporated in the field.</p> <p>Adoption and scaling up of ISFM technologies could be affected by the ownership of the farm that are mainly male owned where the mandoes not own the technology</p>
Gender related opportunities	Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that saves on cost which is good for all gender in the farm household.
VMG issues and concerns in development, dissemination adoption and scaling up	<p>VMGs are physically disadvantaged for a practice that seeks to incorporate manures in the farm.</p> <p>They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice.</p>
VMG related opportunities	The technology if well-practiced can increase farm incomes of VMGs by up to 50%.
<b>E: Case studies/profiles of success stories</b>	
Success stories if any	ISFM successes have been reported in sorghum and millet value chains in Machakos where yields have been improved
Application guidelines for users	<ul style="list-style-type: none"> <li>• Always use well-adapted, disease and pest resistant or tolerant germplasm/seed to make efficient use of available nutrients.</li> <li>• Ensure that good agronomic practices are upheld</li> </ul>

	<ul style="list-style-type: none"> <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
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa
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>2.4.3. 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	<ul style="list-style-type: none"> <li>Conventional methods for soil testing are not cheap to farmers, results take long and not are reproducible.</li> <li>The methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously.</li> <li>Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols.</li> <li>Limited access to soil testing services (centralized soil testing laboratories and cost).</li> </ul>
What is it? (TIMP description)	<p>This is a dry method for soil testing using simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue.</p> <p>It requires partners involved (ICRAF, iSDA and SoilCares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.</p>
Justification	<p>Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.</p>

<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension officers
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> </ul>
Critical/essential factors for successful.	<ul style="list-style-type: none"> <li>• Availability of the necessary equipment for rapid on the spot soil testing.</li> </ul>
	<ul style="list-style-type: none"> <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 finger millet producing 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 measured scanned data, fertilizer recommendation according to crop type suitability). 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; providing 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 analysis reports from accredited laboratories</li> <li>• Agro dealers to stock required fertilizers that is readily available to farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	-
Counties where TIMP will be up scaled	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• It requires continuous updating to improve recommendations.</li> <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>• Use of scanners (spectroscopy) and less wet chemistry analysis.</li> <li>• Automated pipelines for updating existing recommendation methods.</li> </ul>
Lessons learned in upscaling if any	Timely affordable soil information will guide farmers on the right use of fertilizers. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Sulphur

Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• The management practice is socially acceptable-generates income, increases food production, promotes food nutrition security and enhances family cohesion.</li> <li>• It is also environmentally friendly-farmers only apply the required amounts of fertilizers hence, no excess nutrients to contaminate ground and surface water.</li> <li>• Increased yields can avail surplus which can generate extra income.</li> <li>• Supportive policy frameworks are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation.</li> <li>• Shipping selected soil and plant materials for further testing and results verification in a certified lab.</li> </ul>
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns and no doubt will be making agronomy great again.
Gender issues and concerns indevelopment, dissemination adoption and scaling up	By bringing services closer to the users saves time and resources to the farmers (men, women and youth).
Gender related opportunities	Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. Retooling of personnel at national and County levels.
VMG issues and concerns indevelopment, dissemination adoption and scaling up	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and is also expected to improve productivity.
<b>E: Case studies/profiles of success stories</b>	
Success stories	Has been tested used successfully by other organizations like ICRAF, Soil Cares & KESREF. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.
Application guidelines for users	<ul style="list-style-type: none"> <li>• A handheld scanner to 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 samples are 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, KALROsecretariat
Lead organization and scientists	KALRO; C. Kibunja, A. Sila, D. Kamau, A.O. Esilaba
Partner organizations	County governments in the 24 counties, Soil Cares, ICRAF and iSDA

### Research Gaps:

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

## 2.5 Soil and Water Management

2.5.1 TIMP name	Contour bunds
Category (i.e. technology, innovation or management practice)	Management practices
<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)	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 bunds are 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).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Contour bunds resemble narrow channel terraces commonly referred to as " <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 high side of the furrow whereas cereal crops requiring less

	water, such as finger millet, can be planted on the ridges.
<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 information materials distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Most effective approach	Model farm demonstration
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 – Provide 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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if contours are improperly laid</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 equipment for preparation of contour 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>• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance.</li> <li>• Existence of well-developed self-help groups can lead to</li> </ul>
	successful soil and water conservation activities. <ul style="list-style-type: none"> <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</li> </ul>

	willing to invest.
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>• Enforce policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for <i>contour</i> preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Ownership of or access to land may limit women in some regions</li> <li>• Making decisions on land use may limit women in some region where decision making is men dominated</li> <li>• Differing accessibility of the technology and information may disadvantage different gender</li> <li>• The technology is labour intensive hence may disadvantage women and members who cannot procure labour services</li> <li>• Differing accessibility of information between men and women because of gender norms that place access to new information and technologies in the hands of male heads will affect adoption and scaling up.</li> <li>• Ownership of or access to land and credit will affect adoption and scaling up.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural production will increase access to food and income among all gender.</li> <li>• Potential for employment creation - youthful men and women will provide labour during the implementation of the management practice.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited of access to information may limit the VMG from technology access and use</li> <li>• Limited attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges limits use of technologies.</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• Competing priorities and household decisions might hinder</li> </ul>
	adoption and scaling up.
VMG related opportunities	<ul style="list-style-type: none"> <li>• Application of contour bund is expected to improve agriculture production thus, more food and income for</li> </ul>

	the VGMs.
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	-
Application guidelines for users	Soil is excavated up-slope of the bund to a depth of 50cm. Contour bunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400 to 500m. The height of a bund should be at least 25cm and have an approximate spacing of 1-2m. In arid areas, the distance between bunds can be increased to 5-10m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8m across the slope.
<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 and A.O. Esilaba.
Partner organizations	County Governments extension offices.

### 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 the finger millet value chain.
3. Develop low-cost mechanized tools to ease labor demands in contour construction and maintenance.

<b>2.5.2. 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	Unreliable water to sustain a crop as a result of high seasonal rainfall variability leading to total crop failures. Decreased yields leading to food insecurity.
What is it? (TIMP description)	<i>Zai Pits</i> are small planting pits typically measuring 15-30cm in width, 10-20cm deep and spaced 60-80cm. <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).
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> technology has 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 and Technical staff
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 information materials distributed to farmers through farmer groups, Agrovets and the County extension offices.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the application of this management practice is labour intensive.</li> <li>• Farmers and extension staff with skills to design and construct <i>Zai</i> pits.</li> <li>• Availability of affordable organic matter i.e. manure and 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 – to provide on-farm demonstration plots for farmer field schools</li> <li>• NGOs –to provide 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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement at large scale.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of <i>Zai</i> pits for efficiency and increased output per man hour.</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>• Enforcement of policies on soil and water conservation at the County level</li> <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>• Policies that support individual land tenure systems</li> <li>• Provision of support in the establishment of the <i>Zai pits</i></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>• Ownership of or access to land, farming inputs and credit is an important gender issue in the adoption of <i>Zai pits</i>.</li> <li>• Making decisions on land use, what to grow, expenditures and savings is an important gender consideration in <i>Zai Pits</i>. This may disadvantage women</li> <li>• Differing accessibility of the technology between men and women because of gender norms that place access to new information and technologies in the hands of male heads of households is big gender concern in adoption</li> <li>• Ownership of or access to land, farming inputs, information technologies (radios, cell phones) and credit will affect adoption and scaling up.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural produce will increase access to food and income among women, male and youth.</li> <li>• Youthful male and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited of access to information due to factors like physical disability affects technology access</li> <li>• In attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges.</li> <li>• The technology is labour intense 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>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• Competing priorities and household decisions might hinder adoption and scaling up.</li> </ul>

	<ul style="list-style-type: none"> <li>The technology involves carrying of heavy manure to the field during establishment which may be difficult for the physically weak VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Application of <i>Zai</i> pits is expected to improve agriculture production thus, more food and income for the VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	<ul style="list-style-type: none"> <li>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.</li> <li>Farmers in Kathonzweni, Makueni County increased dug pits from 170 to 500 pits for crop production due to initially observed benefits. Communities in ASALs have also rehabilitated degraded lands and increased production by many folds.</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li><i>Zai</i> pits are 5-15cm deep, 15-50cm wide and 80-100cm apart. In dry areas the size of planting pits can be enlarged. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits.</li> <li>The <i>Zai</i> pits are during the dry season when labour constraints are minimal. Each pit is 20-30cm wide, 10-30cm deep, with the soil from the pit thrown downhill to form a crescent shaped dam. The spacing of the pits within a row, as well as the space between the rows of pits varies between 60 and 100cm. At the beginning of the rains, 200-600g of dung or compost (two handfuls of organic matter are approximately 300g) are added to the pits. The organic matter is mixed, in the bottom of the hole, with approximately 5cm soil. Each pit is then sown with 8-12 finger millet seeds.</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	<ul style="list-style-type: none"> <li>Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	<p><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</p>

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Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Ketiem, J. Mwaura; D.Kamau and A.O. Esilaba.
Partner organizations	County Government offices

## GAPS

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

<b>2.5.3. 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)	Bench terraces consist of a series of beds which are more or less level running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for semi-arid to humid regions of rainfall, 700mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50cm; and areas with no gullies, nor stones.
Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
<b>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 information materials which will be distributed to farmers through farmer groups and the county extension service providers.</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 of on-farm</li> </ul>

	demonstration plots to hold farmer field schools.
	<ul style="list-style-type: none"> <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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>Increased risk of soil erosion if terraces are improperly laid</li> <li>Labour intensive during construction and maintenance 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 equipment for preparation of bench terrace for efficiency and increased output per man hour.</li> <li>Training youthful farmers to be champions of making bench terraces construction 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 largely popular 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	<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	The main input cost is the labour for bench terrace preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and	<ul style="list-style-type: none"> <li>Making decisions on land use may limit specific gender</li> <li>Differing accessibility between men and women because of gender norms places access to new information and</li> </ul>

scaling up	<p>technologies in the hands of male heads of will affect adoption and scaling up.</p> <ul style="list-style-type: none"> <li>• Ownership of or access to land and credit will affect adoption and scaling up.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural production will increase access to food and income among all gender.</li> <li>• Both men and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• Lack of access to information will limit the VMG accessing and adopting the technology</li> <li>• Competing priorities and household decisions might hinder adoption and scaling up.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Application of bench terraces is expected to improve agriculture production thus, more food and income for the VMGs.</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</p> <p>"Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed. But when we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new management practice 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 5m for manually constructed ones and from 3.5 to 8m 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 1000mm 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 Governments extension offices.

<b>2.5.4 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)	‘Fanya juu’ terraces (juu is Swahili word for ‘up’) are constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as Finger millet may then be grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off.  The technology is highly suitable in low annual rainfall areas (less than 700mm); moderate slopes (less than 20%); deep soils (more than 60cm); and hilly areas that are subject to widespread erosion.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
<b>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 information materials which will be distributed to farmers through farmer groups and county extension service providers.</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 of on-farm demonstration plots to hold farmer field schools.</li> <li>• External service providers – capacity building and access to management practice.</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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if terraces 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 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 from dissemination	<ul style="list-style-type: none"> <li>• 'Fanya juu' terracing is popular due largely 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>• Similarly, when the farmers are adequately trained and sensitized on the management practice, 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>• Enforce policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Will depend on the land size and the landscape terrain/slope The main input cost is the labour for terrace preparation. The cost
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Ownership of or access to land may limit women in implementing the technology</li> <li>• Limited decision making power on land use may limit women in accessing and adopting the technology</li> <li>• Differing accessibility of the technology and information may disadvantage women and in some instances men</li> <li>• Limited access to credit will affect adoption and scaling up among women.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural production will increase access to food and income among all gender.</li> <li>• Youthful male and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Limited access to information will limit access to information and adoption</li> <li>• Limited decision making power on land use may limit VMG in accessing and adopting the technology</li> <li>• May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges.</li> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Application of contour ridge is expected to improve agriculture production thus, more food and income for the VMGs.</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 high yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runaway water and soil.

Application guidelines for users	The 'fanya juu' trench is 60cm wide by 60cm deep, and the bund 50 cm high by 15cm across 19. In arid regions the trenches can be enlarged to 150 cm deep and 100 cm wide. Distance between bunds can be from 5m on steep slopes to 20m on gentle slopes. Stone terrace walls can be built to reinforce the bunds on very steep slopes to allow surplus water to pass between the stones without damaging the terrace. Excess water can be drained from the trenches using cut-off drains.
<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, 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 Governments extension service.

<b>2.5.5. 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 in most soils
What is it? (TIMP description)	Stone lines are stones placed along contour lines to slow down runoff. With time, the soil builds up on the upslope side of the stone line and a natural terrace is formed. The technology is suitable in gentle to moderate slopes (less than 10%); areas with low annual rainfall areas (200 - 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 information materials distributed to farmers through farmer groups and the county extension service providers.</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	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of</li> </ul>
for scaling up and their roles	information to farmers, technology access, capacity building <ul style="list-style-type: none"> <li>• Community farmer groups to establish 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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if stone lines 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 preparation and laying of stone 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. 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	<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>• Enforce 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	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited ownership of or access to land may limit women from technology implementation</li> <li>• Limited power in making decisions on land use may limit women in technology adoption</li> <li>• The technology is labour intensive and may limit implementation by women</li> </ul>
	<ul style="list-style-type: none"> <li>• Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up.</li> <li>• Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural production will increase access to food and income among all gender.</li> <li>• Men and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to information will limit access to information and adoption</li> <li>• Limited decision making power on land use may limit VMG in accessing and adopting the technology</li> <li>• May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges.</li> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be</li> </ul>
VMG related opportunities	Application of stone lines is expected to improve agriculture production thus, more food and income for the VGMS.
<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 0.5 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> (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. Wamungo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Governments extension service.

<b>2.5.6 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 and increased surface run off
What is it? (TIMP description)	Retention ditches are trenches designed to catch and retain incoming runoff and hold it until it infiltrates into the ground. They can be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The management practice is suitable in semi-arid areas; permeable, deep and stable soils; and on flat or gentle sloping land.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields.
<b>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 information materials which will be distributed to farmers through farmer groups and the county extension service providers.</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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if retention ditches are improperly laid.</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 digging out retention ditches for efficiency and increased output per manhour.</li> <li>• Training youthful farmers to be champions of digging out retention ditches.</li> <li>• Training on site specific designs and layout</li> <li>• Fast-track land registration</li> </ul>
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <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>• Enforce policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for digging retention ditches. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed

Gender issues and concerns in development, dissemination, adoption and scaling up	<p>Limited ownership of or access to land may limit women from technology implementation</p> <p>Limited power in making decisions on land use may limit women in technology adoption</p> <p>The technology is labour intensive and may limit implementation by women</p> <p>Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up.</p> <p>Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women</p>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Increased agricultural production will increase access to food and income among all gender.</li> <li>• Youthful male and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Limited access to information will limit access to information and adoption</li> <li>• Limited decision making power on land use may limit VMG in accessing and adopting the technology</li> <li>• May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges.</li> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Application of contour ridge is expected to improve agriculture production thus, more food and income for the VGMs.</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 high yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of retention trenches in hillside to trap runaway water and soil.
Application guidelines for users	The ditches are dug to about 30-60cm 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 from 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> Ready for upscaling, Requires validation; Requires	Ready for upscaling

further research)	
<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 and A.O. Esilaba.
Partner organizations	County Governments extension service.

<b>2.5.7 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 and increased run off
What is it? (TIMP description)	Grass strips are dense strips of grass planted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively high rainfall amount.
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. The technology is suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and high rainfall areas.
<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 information materials distributed to farmers through farmer groups and the county extension service providers.</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 staff with skills to design and establish grass strips.</li> <li>• Land tenure systems that allows for individual land 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,</li> </ul>

	<p>capacity building</p> <ul style="list-style-type: none"> <li>Community farmer groups – establishment of on-farm demonstration plots to hold farmer field schools; provide collective labor.</li> </ul>
	<ul style="list-style-type: none"> <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	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>Labour intensive in terms of 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 strip establishment.</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 an appropriate source of fodder for farmers who keep livestock (cattle, sheep, donkeys e.t.c).</li> <li>Grass can also be cut, dried and used as mulch for crops by farmers.</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> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed and also type of grass
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Limited ownership of or access to land may limit women from technology implementation</li> <li>Limited power in making decisions on land use may limit women in technology adoption</li> <li>The technology is labour intensive and may limit implementation by women</li> <li>Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up.</li> <li>Limited access to appropriate tools and credit may limit application of technology among specific gender</li> </ul>

	e.g. women
Gender related opportunities	<ul style="list-style-type: none"> <li>Increased agricultural production will increase access to food and income among all gender.</li> <li>Youthful male and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>Limited access to information will limit access to information and adoption</li> <li>Limited decision-making power on land use may limit VMG in accessing and adopting the technology</li> <li>May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges.</li> <li>The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up.</li> <li>The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Application of contour ridge is expected to improve agriculture production thus, more food and income for the VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	Farmers have reported improved reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice.
Application guidelines for users	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 cropped areas. Various grass species are used, e.g., Vetiver, Napier, Guinea and Guatemala depending on what is locally available. Vetiver grass is drought resistant and good for reducing erosion.
<b>F: Status of TIM</b> readiness (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: +24-020-2464435 Ext. 300 E-mail:

	cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D.Kamau and A.O. Esilaba.
Partner organizations	County Governments extension service.

<b>2.5.8 TIMP name</b>	<b>Tied ridges /Ridging /Earthing</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)	Tied ridges are small earthen ridges, 30cm high, with an upslope furrow which accommodates water between the ridges.  Technology consist of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones. Water is applied to the top end of each furrow and flows down the crop field under the influence of gravity.
Justification	With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges helps conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.
Region promoted	Tana River, Garissa, and West Pokot counties
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches used in dissemination	Demonstrations; Farmer Field Schools
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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri,

Any	Meru
Counties where TIMP will be promoted	Kakamega, Buisa, Bungoma, Siaya, Migori, Baringo, West Pokot, Bomet, Kericho, Turkana, Kisii, Nyamira and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Can be labour intensive during establishment phase</li> <li>• Poor management may lead to water use inefficiencies</li> <li>• Limited access to credit may limit uptake</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>• Enhancing farmers' capacity to see benefits</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	To be determined
Estimated returns	To be determined.
Gender issues and concerns in development, dissemination, adoption and scaling up	Being labour intensive, there is likelihood for male dominance hence development prototypes benefit specific gender
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Gender differences in access to credit will limit technology uptake and utilization</li> <li>• Construction is labor intensive, there is likely formale dominance</li> <li>• Gender differences in access to credit will limit technology access, development and uptake</li> </ul>
Gender related opportunities	Opportunities for women and youth to increase income through application of technology in production of specific value chains that favor them
VMG issues and concerns in	<ul style="list-style-type: none"> <li>• Adequate planning and apportioning of space in the</li> </ul>

development and dissemination	irrigation system is necessary with special consideration for VMG to empower their opportunities <ul style="list-style-type: none"> <li>The cost can hinder the rapid adoption by the VMGs due to high poverty levels.</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	-
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 MoALFI: Training Manual for Water Users Association and farmers</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 Secretariat
Lead organization and scientists	KALRO; J. Mwaura, I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority

### GAP

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

<b>2.5.9 TIMP name</b>	<b>Rain water harvesting systems (ponds and dams)</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed:	Water scarcity for agricultural use especially in the face of diminishing rainfall because of climate change

What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site- specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage  By collecting, storing and utilizing water for agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high- value crops, and extending their growing season through the entire year. Technology also slows water runoff and increases yields with the additional water.
<b>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>• Awareness creation through various platforms like local FM stations</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems</li> <li>• Policy to support use of communal land to establish and manage the earth dams</li> <li>• Policies supporting Public-Private Partnerships in water harvesting</li> <li>• Sensitization of local communities to embrace the practice</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 upscaled	ASAL counties, Siaya, West Pokot, Baringo and Turkana,

Challenges in dissemination	<ul style="list-style-type: none"> <li>• High costs related to technology access and management</li> <li>• Resource use conflicts where land is communally owned</li> <li>• Limited skills in technology installation and management</li> <li>• Limited community mobilization policy for water related activities</li> <li>• Lack of suitable training programs in rainwater harvesting</li> <li>• Lack of proper water usage and control measures</li> <li>• In the case of earth dams where there is a lot of siltation, regular de-siltation is required.</li> <li>• Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance.</li> <li>• Vandalism</li> <li>• Some systems require high investment costs.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Resource mobilization through partnerships with private sector</li> <li>• Engaging a participatory process during the planning and implementation of the project.</li> <li>• User specific training programs water harvesting technologies, maintenance and operation skills</li> <li>• Cost of buying water harvesting structures is very high for most households and needs to be reviewed.</li> <li>• Securing systems to prevent vandalism</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	<ul style="list-style-type: none"> <li>• Devise systems that are gender sensitive – target different gender needs</li> <li>• Carry out environment and social impact assessment of the technology in specific counties and cultures</li> <li>• Support structures that help access to credit for technology access and maintenance</li> <li>• Enact Policy frameworks to support water harvesting</li> <li>• Enact policies 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 distance from household need to be considered as women are the custodian of households in terms of domestic water demands.</li> <li>• The design of the water pans should take care of the Occupation, Health and Safety of the communities</li> <li>• The technologies will reduce time needed to fetch for water which will impact positively the women</li> </ul>
Gender related opportunities	Water harvesting facilities save the time spent to collect water from far off, usually by women. The saved time is channeled into other economic activities
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to credit or financial services may limit access to technology</li> <li>• The land tenure systems may inhibit adoption of technology</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Develop SME opportunities around water harvesting. Also do small food gardens and tree nurseries around water pans</li> <li>• VMG maximize can engage in n availability of water to engage in small IGAs around water harvesting</li> <li>• Livestock too easily access water and their market value likely to appreciate</li> <li>• The technology will reduce the time used to search for water</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>
	This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	<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 ResourcesKALRO Secretariat
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPP

## **GAPS**

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

<b>2.5.10 TIMP Name</b>	<b>Conservation Agriculture</b>
Category (i.e. technology, innovation or management practice)	Innovation
<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 in finger millet producing regions
What is it? (TIMP description)	Technology driven by three key principles; reduced soil disturbance, crop rotation and permanent/continuous soil cover
Justification	Land productivity in finger millet production regions is decreasing leading to decreased yield. Continuous land operation continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to: <ul style="list-style-type: none"> <li>- Increases the productivity by improving soil structure and protects the soil against erosion and nutrient losses by maintaining a permanent soil cover and minimizing soil disturbance.</li> <li>- Enhance food security</li> <li>- Conserve soil water</li> <li>- Enhance biodiversity</li> </ul>
Region promoted	Machakos, Nyandarua, Nyeri, West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Women, Youth, and VMGs
Approaches used in dissemination	Agricultural shows Mass media, Chief's Baraza, exhibitions, farmer field schools.
Most effective approach	FFS, Mass media and social media extension
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	County governments, Network of conservation Agriculture, CIAT
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Minimal
Challenges in dissemination	1) Change of mindset 2) non-availability of crop residue in suitable quantities 3) land tenure (farmers reluctant to invest in CA where they do not have clear land rights)
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Conduct assessment to determine the impact of CA on finger millet diseases especially blast</li> </ul>

	<ul style="list-style-type: none"> <li>• Enhance 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>• Economic, social and cultural assessment of perceptions towards CA</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	<ul style="list-style-type: none"> <li>- Mind sets negative about CA.</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 under CA
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation Reduction in losses experienced in dry areas due to rainfall variability Actual costs to be estimated
Estimated returns	Returns on conserving soil exceeding 150 tons/hectare annually and associated increased productivity Actual returns in finger millet production to be assessed
Gender issues and concerns in development and dissemination	CA is a technology that can be easily adopted by women and VMGs. Reduced tillage would reduce time spent preparing land and hence a benefit to women and VMGs, the main producers of the crop
Gender issues and concerns in adoption and scaling up	CA with agroforestry provides opportunities for SMEs e.g. tree nurseries. The technology therefore renders itself to easy adoption by women, youth groups and VMGs
Gender related opportunities	SMEs e.g. tree nurseries for agro forestry Increased income from reduced labor costs and increased yield in years of low rainfall
VMG issues and concerns in development and dissemination	The technology and management practices can be easily carried out by Vulnerable and marginalized groups
VMG issues and concerns in adoption and scaling up	Currently the uptake by VMG is dismal
VMG related opportunities	SMEs such as tree nurseries for increased resilience
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	Adopters of CA will need training Guidelines to be provided through production leaflets
<b>F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)</b>	3 – Requires further research in finger millet production
<b>G: Contacts</b>	

Contacts	The Centre Director, KALRO-Kisii, P.O. Box 523-40200, KISII; e-mail address: <a href="mailto:chrispus.oduori@kalro.org">chrispus.oduori@kalro.org</a> ; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ +254 (0) 771 437 985
Lead organization and scientists	KALRO NRM Team: Mwaura J., Kamau D., Esilaba A., Ketiem P., Mutuma, Kasina M, C.O.A. Oduori.
Partner organizations	County government, Private Public Partnerships

## 2.6 Finger Millet Crop Health


<b>2.6.1 TIMP name</b>	<b>Scouting for timely identification and control of Finger millet pests and diseases.</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 awareness by farmers on the need to undertake scouting in their fields.
What is it? (TIMP description)	This TIMP focuses on regular application of field inspection and monitoring techniques to determine the presence of the different types of pests and diseases and their respective severities in order to make a decision on how and when to control them.
Justification	This management practice will minimize indiscriminately application of control measures in finger millet. It also gives farmers an opportunity to understand purpose is to understand the pests and diseases attacking finger millet, economic thresholds and life cycle stages of pests with economic significance.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension service providers, agro-dealers.
Approaches to be used in Dissemination	Extension publications On-farm demonstrations Farmer field days. FFBS Agriculture innovation platforms Farmer training Agricultural shows and exhibitions as well as farmer to farmer training.
Critical/essential factors for successful promotion	Collaboration between all partners. Adequate facilitation: funds, logistics (transport) Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chains stakeholders

Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct farmer trainings. Individual farmers and farmer groups/CBO to participate in the implementation of the various technologies for Finger millet production.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	There is no quantifiable data where these management practices have been adapted by finger millet producers in Kenya.
Counties where TIMPs will be upscaled	Kericho, Bomet, West Pokot, and other Counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset in favour of current practices maybe difficult to achieve in certain communities.
Suggestions for addressing the challenges	Capacity building and sensitization forums. Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness.
Lessons learned in up scaling, if any	Farmer participatory approach is effective.
Social, environmental, policy and market conditions necessary for development and up scaling	The management practice is socially acceptable and environmentally friendly to Finger millet production systems.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately KES 400 per day for 3 months.
Estimated returns	KES 500,000 per acre.
Gender issues and concerns in development, dissemination adoption and scaling up	All gender categories can participate in field scouting of Finger millet crop and this has a potential to increased yields of quality heads while reducing production costs.
Gender related opportunities	Opportunities for male and female youth employment in implementing scouting protocols are possible with little technical knowledge for various operations.
VMG issues and concerns in development, dissemination adoption and scaling up	The VMGs can easily participate in crop scouting once sensitized and this validates their inclusion into the production of Finger millets.
VMG related opportunities	Scouting for Finger millet diseases can easily be undertaken by VMGs and hence lead to a reduction in costs for pesticides.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for Users	Esilaba, A.O. et al. (2021). KCEP-CRAL Millet Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya

<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling.
<b>G: Contacts</b>	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and Scientists	KALRO (FCRC Muguga) - Harun Odhiambo,
Partner organizations	County and private Agricultural Extension service providers CGIAR's Agriculture-based NGOs and FBOs.

### Research Gap

Development of surveillance software systems for monitoring pests in Finger millet fields.

<b>2.6.2 TIMP name</b>	<p><b>Cultural management of Shoot Fly (<i>Atherigon asocata</i>) in Finger millet</b></p>  <p>Dead heart of the whorl leaves caused by shoot fly damage Photo source: ICRISAT</p>
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 of Finger millet
What is it? (TIMP description)	Cultural control of seedling blight in Finger millet is an effective approach to control this disease in an eco-friendly manner. The cultural management practices include; early planting 7 to 10 days before the onset of rains to enable the crop escape shoot fly high population densities, planting with phosphorus and nitrogen fertilizer and avoid animal manure since shoot flies are attracted by manure, establishment of trap crops like mustard in strips, encouragement of natural enemies, removal of weeds that

	<p>may serve as alternate hosts, crop rotation with non-poaceae crops and cut off infested leaves and kill the caterpillars inside.</p> <p>It also involves the adoption of good crop husbandry in the farm including weeding and clearing of alternate hosts around the farm especially grass family, use high seeding rates during planting to achieve the desired optimum plant population, practice crop rotation and intercropping with sunflower, cotton or legumes.</p>
Justification	<p>The management practice is an environmentally friendly disease control approach thus a suitable substitute for use of hazardous synthetic pesticides.</p> <p>The management practice is also compatible with other Integrated Pest Management options and contributes to safe produce that meets consumer preference both in the local and regional markets.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<p>Farmers Extension service providers Agro-dealers.</p>
Approaches to be used in Dissemination	<p>Extension publications On-farm demonstrations Farmer field days. Farmer training Agricultural shows and exhibitions as well as farmer to farmer training. FFBS Agricultural Innovation Platforms</p>
Critical/essential factors for successful promotion	<p>Collaboration between all partners. Adequate facilitation: funds, logistics (transport) A platform for interaction of Finger millet value chain stakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings. Individual farmers and farmer groups/CBO to participate in the implementation of this management practice for improvement of Finger millet yields.</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if Any	Kericho, Bomet, West Pokot.
Counties where TIMPs will be Upscaled	All other Counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of farmer mindsets from the use current practices such as application of synthetic pesticides may be difficult to achieve.

Suggestions for addressing the Challenges	Promoting awareness among farmers about the benefits of the management practice Strengthened public-private partnerships.
Lessons learned in up scaling, if any	Strengthened public-private-producer partnerships are key for improved accessibility and adoption of the management practice.
Social, environmental, policy and market conditions necessary for development and up scaling	Strengthened public-private partnerships Promotion of environmentally friendly pest management options Development and promotion of an IPM policy.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	(KSH.13, 068/ha to KSH.4,686/ha).
Estimated returns	Reduce infestation by over 80% (Av.28.4t/ha to 33.1t/ha).
Gender issues and concerns in development, dissemination adoption and scaling up	All gender categories can participate in field scouting of Finger millet crop and this has a potential to increased yields of quality heads while reducing production costs.
Gender related opportunities	Opportunities for male and female 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 VMGs can easily participate in crop scouting once sensitized and this validates their inclusion into the production of Finger millets.
VMG related opportunities	Application of cultural management practices for Finger millet pests can easily be undertaken by VMGs and hence lead to a reduction incosts for pesticides.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Reference Esilaba, A.O.et al. (2021). KCEP-CRAL Millet Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya
<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 Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO (FCRC Muguga) – Harun Odhiambo, David Lelgut and Vincent Ochieng’
Partner organizations	County and private Agricultural Extension service providers, CGIAR’s Agriculture-based NGOs and FBOs.


## Research gap

1. Evaluation of various cultural management practices Shoot fly under different finger sorghum systems.

<b>2.6.3 TIMP name</b>	<b>Identification of disease-free areas for production of Finger millet.</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 loses due to high disease incidences
What is it? (TIMP description)	<p>This management practice involves the selection of suitable area or field for cultivation of Finger millet for better yields. Many fungal and bacterial diseases are more severe in wet areas than in dry areas.</p> <p>It is also advisable not to use the same field for cultivation of Finger millet year after year. Selection of same field may aggravate, for example, seedling blight, and Cercospora leaf spot.</p> <p>The drainage in the field is also important since low-lying, waterlogged conditions favour most fungal diseases such as damping off and root rots in various agricultural crops.</p>
Justification	The inoculum load of soil-borne pathogens can be lowered by avoiding infected areas for 5 to 6 years since this practice will deprive the pathogens of extra substrate for multiplication.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension service providers, agro-dealers.
Approaches to be used in Dissemination	<p>Extension publications</p> <p>On-farm demonstrations Farmer field days.</p> <p>Farmer training</p> <p>Agricultural shows and exhibitions as well as farmer to farmer training.</p> <p>Farmer Field and Business Schools</p> <p>Agriculture innovation platforms</p>
Critical/essential factors for successful promotion	<p>Collaboration between all partners.</p> <p>Adequate facilitation: funds, logistics (transport)</p> <p>A platform for interaction of Finger millet value chain stakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings.</p> <p>Individual Farmers and farmer groups/CBO to participate in the implementation of this management practice for successful production of Finger millets.</p>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted, if any	-
Counties where TIMPs will be up scaled	Kericho, Bomet, West Pokot and all other Counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset by farmers in favour of current practices maybe difficult to achieve. Lack of Finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the Challenges	Capacity building and sensitization forums. Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness Establish Finger millet innovation platforms
Lessons learned in up scaling, if Any	Farmer participatory approach is effective. Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform. Partnership is important in dissemination and adoption and this can be facilitated through innovation platforms.
Social, environmental, policy and market conditions necessary for development and up scaling	The practice can limit excessive use of pesticides and lower
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately Ksh 50,000 per acre.
Estimated returns	Approximately Ksh 500,000 per acre.
Gender issues and concerns in development, dissemination adoption and scaling up	All gender categories can participate in field scouting of Finger millet crop and this has a potential to increased yields of quality heads while reducing production costs.
Gender related opportunities	Opportunities for male and female youth employment in implementing IDM protocols are possible with little technical knowledge for various operations.
VMG issues and concerns in development, dissemination adoption and scaling up	The VMGs can easily participate in crop scouting once sensitized and this validates their inclusion into the production of Finger millets.
VMG related opportunities	IDM for Finger millet diseases can easily be undertaken by VMGs hence, lead to a reduction in production costs.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Do not to use the same field for cultivation of Finger millet year after year. Avoid low-lying, waterlogged conditions Avoid areas with high disease pathogen inoculum for 5 to 6 years

<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation.
<b>G: Contacts</b>	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya
Lead organization and scientists	KALRO-Katumani, Daniel Mutisya., Nzioki H., Ruth Amata of KALRO-Kabete, Oduori C.O.A. KALRO (FCRC Muguga) – Harun Odhiambo,
Partner organizations	County and private Agricultural Extension service providers CGIAR's Agriculture-based NGOs and FBOs.

<b>2.6.4 TIMP name</b>	<b>Integrated Pest Management of Finger millet stem borer</b> 
	Heavy infestation cause leaf yellowing
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 crop infestation and damage by the pest
What is it? (TIMP description)	Integrated Pest Management (IPM) is practice of using a combination of biological, cultural, mechanical, host plant resistance and chemical control practices for the management of Stem borer in Finger millet fields. In IPM practices, the use of agro-chemicals is usually considered as a last option after undertaking all the other pest control practices and realizing that the pests are still attacking the crop.  The cultural practices include use of resistant varieties if locally available, planting early, with the first rains, intercrop millet with crops such as, cowpeas, beans and pigeon peas, destroying crop residues after harvest.

	Use of ‘push-pull’ method against stem borers by intercropping cowpea or dolichos with millet to act as a repellent that ‘pushes’ the pest away from the millet is also encouraged. Planting a trap crop such as Brachiaria or Sudan grass around the border of the field to attract or ‘pull’ the stem borer moths away from the millet also applies.
Justification	Adoption of IPM practices for control of stem borer in the fields will not only reduce the costs for purchase of pesticides but will also make the final produce safe for consumption.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension service providers, agro-dealers.
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days. Farmer training Agricultural shows and exhibitions as well as farmer to farmer training. Farmer Field and Business Schools Agriculture Innovation Platforms
Critical/essential factors for successful promotion	Collaboration between all partners. Adequate facilitation: funds, logistics (transport) Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings. Individual Farmers and farmer groups/CBO to participate in the implementation of this management practice for successful production of Finger millets.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Kericho, Bomet and West Pokot
Counties where TIMPs will be Upscaled	All other Counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset by farmers in favour of current practices maybe difficult to achieve. Applied and adaptive research to develop test, validate and release improved Finger millet varieties with tolerance to stem borer. A platform for interaction of Finger millet value chain stakeholders
Suggestions for addressing the challenges	Capacity building and sensitization forums.

	<p>Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness</p> <p>Establish Finger millet innovation platforms</p>
Lessons learned in up scaling, if Any	<p>Farmer participatory approach is effective.</p> <p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an Innovation Platforms</p> <p>Partnership is important in dissemination and adoption and this can be facilitated through innovation platforms</p>
Social, environmental, policy and market conditions necessary for development and up scaling	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	Approximately Ksh 50,000 per acre.
Estimated returns	Approximately Ksh 500,000 per acre.
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 Finger millet cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as seeds and chemicals 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 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 than men</li> <li>• Men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youth employment exist in implementing IPM protocols</li> <li>• Use of the farmer field and business school strategy for effective training of farmer groups</li> <li>• on Finger millets production and marketing</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<p>VMGs may have less access to markets</p> <p>VMGs have limited access to land for Finger millet cultivation than men</p> <p>VMGs may have less access to credit</p> <p>VMGs may also have limited access to finances to buy the required inputs such as seeds and chemicals than men</p> <p>VMGs have less access to agricultural information, technology and knowledge than men</p> <p>High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials</p>

VMG related opportunities	<p>Opportunities for youth and those recovering from drugs employment exist in implementing IPM protocols</p> <p>Affirmative action in various areas as for instance in the provision of finances to VMGs</p> <p>Increased production will lead to increased consumption and utilization of Finger millets hence improved health of VMGs</p>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	<p>Reference:</p> <p>Esilaba, A.O.<i>et al.</i> (2021). KCEP-CRAL Millet Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya</p>
<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 Centre Director Food Crops Research Centre – Muguga South
	P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO-Katumani, Daniel Mutisya., Nzioki H., Ruth Amata of KALRO-Kabete, Oduori C.O.A. KALRO (FCRC Muguga) – Harun Odhiambo,
Partner organizations	County and private Agricultural Extension service providers CGIAR's Agriculture-based NGOs and FBOs.

<b>2.6.5 TIMP name</b>	<p><b>Integrated Pest Management of Cut worms in Finger millet.</b></p> <div style="text-align: center;">  </div> <p>(Source: <a href="http://www.aicrpsm.res.in/Downloads/Publications/">http://www.aicrpsm.res.in/Downloads/Publications/</a>), India</p>
Category (i.e. technology, innovation or management practice)	Management practice

<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield loss due to crop damage.
What is it? (TIMP description)	Integrated control practice for Finger millet cut worm is the use of a combination of biological, cultural, and chemical control methods in Finger millet fields to manage the pest.
Justification	The application of biological control using bio-pesticides such as <i>Bacillus thuringiensis</i> as one of the Integrated Pest Management options for Cut worms is not only effective, but environmentally safe. The bio-pesticides also double as plant growth promoters thereby increasing yields be used to control the pests. Judicious application of chemical control method using 5% Malathion dust around germinated Finger millet plants preferably in the afternoon, Dipterex (Dylox) Trichorphon 5% dust at 2 kg/ha and baits e.g. Bran mixed with sugar or spraying pyrethroid insecticides is equally effective against Cut worms.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in Dissemination	Extension publications On-farm demonstrations Farmer field days. Farmer training Agricultural shows and exhibitions as well as farmer tofarmer training. Farmer Field and Business SchoolsAgricultural Innovation Platforms
Critical/essential factors for successful promotion	Requires a strong partnership between technical personnel / extension and farmers. Availability of adequate funds to facilitate promotion. Applied and adaptive research to develop, test, validate and release improved Finger millet varieties with high tolerance to Cut worm infestation. A platform for interaction of Finger millet value chain stakeholders

Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings. Individual Farmers farmer groups/CBO to participate in the implementation of this management practice for successful production of Finger millets.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Kericho, Bomet and West Pokot
Counties where TIMPs will be Upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset in favour of recommended practices maybe difficult to achieve especially on the use of synthetic pesticides. Where farmers would not afford the synthetic insecticides, IPM components will be limited to cultural and biological options hence, some damage might occur on the Finger millet crop. Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chain stakeholders.
Suggestions for addressing the Challenges	Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness. Training farmers on how to apply crop rotation, establish repellent/trap crops and prepare botanical extracts to suppress the soil borne pests. Establish Finger millet innovation platforms
Lessons learned in up scaling, if Any	Little experience has been gathered on the use of bio-pesticides in controlling cut worms and Finger millet root maggots across the Finger millet producing regions of Kenya. Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform. Partnership is important in dissemination and adoption and this can be facilitated through innovation platforms.
Social, environmental, policy and market conditions necessary for development and up scaling	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	Ksh 50,000 per acre
Estimated returns	Ksh 500,000 per acre

<p>Gender issues and concerns in development, dissemination adoption and scaling up</p>	<p>Women and youth have limited access to land for Finger millet cultivation than men          Women and youth may also have limited access to finances to buy the required inputs such as seeds and chemicals than men.          Women and youth may have limited access to farminputs than men          Women and youth may have less access to credit than men          Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles          Women have less access to agricultural information, technology and knowledge than men</p>
<p>Gender related opportunities</p>	<p>Opportunities for youth employment exist in implementing IPM protocols          Use of the farmer field and business school strategy for effective training of farmer groups on Finger millets production and marketing</p>
<p>VMG issues and concerns in development, dissemination adoption and scaling up</p>	<ul style="list-style-type: none"> <li>• VMGs may have less access to markets</li> <li>• VMGs have limited access to land for Finger milletcultivation than men</li> </ul>
	<ul style="list-style-type: none"> <li>• VMGs may have less access to credit</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as seeds and chemicalsthan men</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</li> <li>• other materials</li> </ul>
<p>VMG related opportunities</p>	<ul style="list-style-type: none"> <li>• Opportunities for youth and those recovering from drugs employment exist in in implementing IPM protocols</li> <li>• Affirmative action in various areas as for instancein the provision of finances to VMGs</li> <li>• Increased production will lead to increased consumption and utilization of Finger millets hence</li> <li>• improved health of VMGs</li> </ul>
<p><b>E: Case studies/profiles of success stories</b></p>	
<p>Success stories</p>	<p>-</p>

Application guidelines for users	Reference North Carolina State University, Insect and Related Pests of Vegetable Crops (edited by K. A. Sorensen and J. R. Baker): <a href="http://ipm.ncsu.edu/AG295/html/index.html">http://ipm.ncsu.edu/AG295/html/index.html</a>
<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 Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO (FCRC Muguga South) – Mr. Vincent Ochieng KALRO (FCRC Muguga) – Dr David Lelgut KALRO (FCRC Kabete) – Harun Odhiambo
Partner organizations	County and private Agricultural Extension service providers CGIAR's Agriculture-based NGOs and FBOs.


<b>2.6.6 TIMP name</b>	<b>The use of soil amendments in suppressing soil borne pathogens of Finger millet (Leaf/Head blast and Millet smut)</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low productivity and yield loss due to crop infection by soil borne pathogens (Leaf/Head blast and Millet smut)
What is it? (TIMP description)	This is the compost, organic manure, liquids enriched with essential oils, phenols, organic acids and many other biocidal compounds from herbs to improve soil conditions and crop productivity and aid in suppressing soil borne pathogens.
Justification	Organic manures made up of organic wastes, composts and peats, have been reported to control soil borne diseases and pests. <i>R. solani</i> , <i>Thielaviopsis basicola</i> , <i>V. dahliae</i> , species of <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> and <i>Sclerotium</i> are found to be managed effectively by the application of organic amendments. These organic amendments not only improve soil structure and increase water holding capacity, they also support other beneficial microorganisms which help to suppress soil borne pathogens.

	<p>The increase in activity of microorganisms in the soil creates competition, which may lead to effective suppression of harmful soilborne pathogens.</p> <p>The use of compost extract containing huge populations of microbiota, e.g., <i>Rhizobacteria</i>, <i>Trichoderma</i> and <i>Pseudomonas</i> species, can produce plant growth regulators and chemicals such as phenols or tannins which have an antagonistic effect against soil borne pathogens.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Extension Agents (Public and Private) Research organizations and universities CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Extension publications</li> <li>• On-farm demonstrations Farmer field days Farmer training</li> <li>• Agricultural shows and exhibitions Farmer to farmer training</li> <li>• Farmer Field and Business Schools Agriculture Innovation Platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Strong partnership linkages</li> <li>• Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended practices resulting to effective control of the pest.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension service providers (Public and private) to help in the dissemination.</li> <li>• CGIAR's</li> <li>• NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers.</li> </ul>

	<ul style="list-style-type: none"> <li>• NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	<p>Change of mindset in favour of current practices maybe difficult to achieve.</p> <p>Applied and adaptive Research to test, validate and release improved Finger millet varieties</p> <p>A platform for interaction of Finger millet value chain stakeholders</p>
Suggestions for addressing the challenges	<p>Capacity building and sensitization forums.</p> <p>Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness</p> <p>Establish Finger millet innovation platforms</p>
Lessons learned in up scaling, if Any	-
Social, environmental, policy and market conditions necessary for development and up scaling	<p>Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices.</p> <p>Training on soil amendments to increase awareness and reduce possible negative impact on the environment resulting from the injudicious use of pesticides.</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh. 40,000 per acre
Estimated returns	Varied for food security and income from sales of surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	<p>Women and youth have limited access to land for Finger millet cultivation than men</p> <p>Women have less access to agricultural information, technology and knowledge than men.</p>



Gender related opportunities	Field sanitation can be easily practiced by the various gender categories Use of the farmer field and business school strategy for effective training of farmer groups on Finger millets production and marketing.
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have less access to agricultural information, technology and knowledge than men High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	Field sanitary practices can easily be undertaken by VMGs thus, leading to a reduction in costs for pesticides Increased production will lead to increased consumption and utilization of Finger millets hence improved health of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories if any	-
Application guidelines for users	Reference Milan Panth, Samuel C. Hassler and Fulya Baysal-Gurel (2020). Methods for Management of Soil borne Diseases inCrop Production Tennessee State University, Department of Agricultural and Environmental Sciences, Otis L. FloydNursery Research Center, McMinnville, TN 37110, USA; mpanth@my.tnstate.edu (M.P.); shassler@tnstate.edu (S.C.H.)
<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535  The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO-Katumani, Daniel Mutisya., Nzioki H., Ruth Amata of KALRO-Kabete, Oduori C.O.A. KALRO (FCRC Muguga) – Dr David Lelgut KALRO (FCRC Kabete) – Harun Odhiambo

Partner organizations	Extension service providers CGIAR's NGOs County governments
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<b>2.6.7 TIMP name</b>	<b>Control of Damping off of Finger millet by soil solarization.</b>
	 <p>Wire-stem and wilting of the seedlings from damping off Source: R. Gregory - Plant diseases library</p>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low productivity and yield due to poor crop stand as a result of seedling infection by Damping off disease
What is it? (TIMP description)	Soil solarization is the placement of transparent plastic sheets over the production bed after sufficient irrigation to trap solar radiation which then heats the soil layers thus killing fungi, bacteria, oomycetes, nematodes, insects, and weed seeds in the soil.
Justification	The innovation is a less costly in terms of labour and eco-friendly method for the control of Damping off disease pathogens which live in the soil. It can also be applied by most smallholder farmers most of whom lack professional skills since the innovation does not require much skill.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Extension Agents (Public and Private) Research organizations and universities CGIAR's

Approaches to be used in Dissemination	<p>Extension publications</p> <p>On-farm demonstrations</p> <p>Farmer field days</p> <p>Farmer training</p> <p>Agricultural shows and exhibitions</p> <p>Farmer to farmer training</p> <p>Farmer Field and Business Schools</p> <p>Agricultural Innovation Platforms</p>
Critical/essential factors for successful promotion	<p>Strong partnership linkages</p> <p>Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended innovation resulting to effective control of the disease.</p> <p>A platform for interaction of Finger millet value chain stakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Extension service providers (Public and private) to help in the dissemination.</p> <p>CGIAR's</p> <p>NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers.</p> <p>NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	-
Counties where TIMPs will be Upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset in favour of current practices may be difficult to achieve.
Suggestions for addressing the challenges	<p>Capacity building and sensitization forums.</p> <p>Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness.</p> <p>Establish Finger millet Innovation Platforms</p>
Lessons learned in up scaling, if Any	-

Social, environmental, policy and market conditions necessary for development and up scaling	<p>Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices.</p> <p>Training on solarization to increase awareness and reduce possible negative impact on the environment resulting from application of hazardous options such as excessive use of pesticides.</p> <p>Vegetable markets are able to absorb increased supply of high-quality Finger millets.</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh. 30,000 per acre
Estimated returns	Varied for food security and income from sales of surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	<p>Women and youth have limited access to productive resources such as land, credit, and equipment for soil solarization than men</p> <p>Women have limited access to education, training and extension services than men</p> <p>Women have less access to agricultural information, technology and knowledge</p>
Gender related opportunities	Opportunities for youths and women in performing the operation
VMG issues and concerns in development, dissemination adoption and scaling up	<p>VMGs have limited access to productive resources such as land, credit, and equipment for solarization than men</p> <p>VMGs have limited access to training and extension services</p>
	<p>Due to their social status VMGs are often excluded from decision making in development and dissemination activities</p> <p>VMGs have limited access to information on production techniques</p> <p>There is low adoption by VMGs due lack of awareness</p>
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in implementing the technology
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cases to note are individual farmers and groups sensitized on importance of field sanitation in previous projects and are now practicing it in commercial Finger millet production in major Finger millet growing areas.

Application guidelines for users	Reference Milan Panth, Samuel C. Hassler and Fulya Baysal-Gurel (2020). Methods for Management of Soil borne Diseases inCrop Production Tennessee State University, Department of Agricultural and Environmental Sciences, Otis L. FloydNursery Research Center, McMinnville, TN 37110, USA; mpanth@my.tnstate.edu (M.P.); shassler@tnstate.edu (S.C.H.)
<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director Food Crops Research Centre – Muguga SouthP. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO (FCRC Muguga) – Harun Odhiambo, Vincent Ochieng, Ruth Amata, Miriam Otipa and Jesca Mbaka
Partner organizations	County and private Agricultural Extension service providers CGIA R’s Agriculture-based NGOs and FBOs
<b>2.6.8 TIMP name</b>	<b>Integrated Pest Management of root, stem and foliar aphids in Finger millet</b>
	 <p>Heavy infestation cause leaf yellowing</p> <p>Photo source: ICRISAT</p> 

	Heavy infestation causing yellowing Source: ICRISAT
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield loss due to crop damage by the pest.
What is it? (TIMP description)	Management of aphids in Finger millet through the simultaneous application of a various options (cultural,biological and chemical).
Justification	Cultural practices for the control of aphids such as keeping the field clean from alternate hosts e.g. milkweed, observing correct planting space to avoid high plant density and maintaining flowering hedge of <i>Lantana camara</i> around the farm to enhance conservation of natural enemies can effectively work and are also friendly to the environment. Biological approaches such as spraying od crops with biopesticides e.g. Neem based product “Achook”, seed dressing with Thiamethoxam (Cruiser), Imidacloprid (Gaucho) based products are also suitable for effective control of the pests. Application of Acetamiprid, Lambda cyhalothrin Pentagon and deltamethrin Apm, all at a rate of 10-15 20ml /L of water can also reduce the population of aphids. The combined application of these aphid control options constitute the Integrated Pest Management practice.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR’s
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days. Farmer training


	<p>Agricultural shows and exhibitions as well as farmer tofarmer training.</p> <p>Farmer Field and Business SchoolsAgriculture Innovation Platforms</p>
Critical/essential factors for successful promotion	<p>Requires a strong partnership between technical personnel / extension and farmers.</p> <p>Accessibility and cost of the practice by farmers: low-costagricultural practices and timely application of insecticides.</p> <p>A platform for interaction of Finger millet value chainstakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Extension service providers (Public and private) to help in the dissemination of various IPM components. Others are CGIAR's, NGOs through on-farm demonstrations; capacity building of farmers, Countygovernments extension personnel.</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Kericho, Bomet and West Pokot
Counties where TIMPs will be Upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	<p>Where farmers would not afford the synthetic insecticides and raw materials for preparation of plant extracts/botanicals, IPM components will be limited to cultural measures and some yield loss may occur due to cropdamage.</p> <p>A platform for interaction of Finger millet value chainstakeholders</p>
Suggestions for addressing the Challenges	<p>Training farmers on how to apply botanical pesticides and spray solutions (Ammonia and soap solutions) and promote conservation of biological agents to suppressFinger millet aphids.</p> <p>Establish Finger millet Innovation Platforms</p>
Lessons learned in up scaling, if Any	<p>Little experience has been gathered on the use of botanicals in controlling aphids across the Finger millet producing regions of Kenya.</p> <p>Chances of successful scaling are higher when diversevalue chain stakeholders collaborate in an innovation platform</p> <p>Partnership is important in dissemination and adoption andthis can be facilitated through Innovation Platforms</p>

Social, environmental, policy and market conditions necessary for development and up scaling	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	Financial implications for the acquisition of synthetic pesticides and raw materials for preparation of plant extracts is a pre-requisite for incorporating synthetic pesticides and botanicals as part of the IPM strategy for Finger millet aphids.
Estimated returns	Varied for food security and income from sales of surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	<p>Women and youth have limited access to productive resources such as land, credit, and chemicals than men</p> <p>Women have limited access to education, training and extension services than men</p> <p>Women have less access to agricultural information, technology and knowledge</p>
Gender related opportunities	Opportunities for youths exists in spraying the crop
VMG issues and concerns in development, dissemination adoption and scaling up	<p>VMGs have limited access to productive resources such as land, credit, and chemicals than men</p> <p>VMGs have limited access to training and extension services</p> <p>Due to their social status VMGs are often excluded from decision making in development and dissemination activities</p> <p>VMGs have limited access to information on production techniques</p> <p>There is low adoption by VMGs due lack of awareness</p>
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	-
Application guidelines for users	<p>References</p> <p>North Carolina State University, Insect and Related Pests of Vegetable Crops (edited by K. A. Sorensen and J. R. Baker):</p> <p><a href="http://ipm.ncsu.edu/AG295/html/index.html">http://ipm.ncsu.edu/AG295/html/index.html</a></p> <p>Frank A. Hale, Isaac Deal and Jerome F. Grant. Vegetable Pests; Aphid (also called Finger millet Aphid) The University of Tennessee, Institute of Agriculture (Extension)</p>

<b>F: Status of TIMP readiness</b> (e.g. 1-Ready for upscaling, 2-Requires validation, 3-Requires further research)	Ready for upscaling (Use of insect predators), Requires validation (Use of plant extracts/botanicals) Requires further research (Use of Ammonia and Soap solutions),
<b>G: Contacts</b>	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO-Katumani, Daniel Mutisya., Nzioki H., Ruth Amata of KALRO-Kabete, Oduori C.O.A. KALRO (FCRC Muguga) – Harun Odhiambo,
Partner organizations	Public and private extension service providers CGIAR's Agriculture-based NGOs and FBOs County governments

### Research gap



1. Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management

<b>2.6.9 TIMP name</b>	<p><b>Soil steam sterilization for the management of damping off and seedling blight diseases of Finger millet.</b></p>  <p>Soil steam sterilization process Source: <a href="http://soil-steaming-steam-boiler-blog.com">Soil-steaming-steam-boiler-blog.com</a></p>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low productivity and yield loss due to crop infection by soil borne pathogens
What is it? (TIMP description)	Soil steam sterilization is a technique used to kill soil borne pathogens by injection of hot water vapours/steam in the soil using boilers and conductors.

Justification	This innovation suppresses the soil borne pathogen inoculum before planting thereby limiting crop infections by such pathogens after field establishment. It is also recommended as an environmentally friendly approach since it doesn't have harmful residual effects to the soil.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Extension Agents (Public and Private) Research organizations and universities CGIAR's
Approaches to be used in dissemination	Extension publications On-farm demonstrations Farmer field days Farmer training Agricultural shows and exhibitions Farmer to farmer training Agriculture Innovation Platforms Farmer Field and Business Schools
Critical/essential factors for successful promotion	Strong partnership linkages Need for farmer involvement helps to upscale the management practice since their active participation enhances uptake of the recommended practices resulting to effective control of the pest. A platform for interaction of Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Extension service providers (Public and private) to help in the dissemination. CGIAR's NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	-
Counties where TIMPs will be Upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset in favour of current practices maybe difficult to achieve. A platform for interaction of Finger millet value chain stakeholders
Suggestions for addressing the challenges	Capacity building and sensitization forums. Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on cost effectiveness Establish Finger millet Innovation Platforms

Lessons learned in up scaling, if Any	-
Social, environmental, policy and market conditions necessary for development and up scaling	Understanding the physical and biotic environment intarget ecologies; understanding community culture, preferences, and practices. Training on soil steaming to increase awareness and reduce possible negative impact on the environment.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh. 40,000 per acre
Estimated returns	Varied for food security and income from sales of surplus.
Gender issues and concerns in development, dissemination adoption and scaling up	Women and youth have limited access to productive resources such as land, credit, and equipment than men Women have limited access to education, training and extension services than men Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Opportunities for youths exists in performing the operation
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs have limited access to productive resources such as land, credit, and equipment than men VMGs have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities
	VMGs have limited access to information on production techniques There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities for unemployed youths and those recovering from drugs exists in performing the operation
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cases to note are individual farmers and groups sensitized on importance of field sanitation in previous projects and are now practicing it in commercial Finger millet production in major Finger millet growing areas.
Application guidelines for users	Reference Milan Panth, Samuel C. Hassler and Fulya Baysal-Gurel (2020). Methods for Management of Soilborne Diseases in Crop Production Tennessee State University, Department of Agricultural and Environmental Sciences, Otis L. Floyd Nursery Research Center, McMinnville, TN 37110, USA; mpanth@my.tnstate.edu (M.P.); shassler@tnstate.edu (S.C.H.)
<b>F: Status of TIMP readiness</b> (e.g.	Requires validation

1-Ready for upscaling, 2-requires validation, 3-requires further research)	
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO (FCRC Muguga) – Harun Odhiambo, KALRO (FCRC Kabete) – Miriam Otipa and Ruth Amata
Partner organizations	County and private Agricultural Extension service providers CGIA R's Agriculture-based NGOs and FBOs.

<b>2.6.10 TIMP name</b>	<b>Management of foliar diseases (Downy mildew and Cercospora leafspot) of Finger millet by use of integrated disease management practices.</b>	
		
	Downy mildew on Finger millet leaf	Cercospora leaf spot on Finger millet leaf
Category (i.e. technology, innovation or management practice)	Management practice	
<b>A: Description of the technology, innovation or management practice</b>		
Problem addressed	Yield loss due to crop damage.	
What is it? (TIMP description)	Integrated control practice for Finger millet foliar uses a combination of biological, cultural, and chemical control methods in Finger millet fields.	
Justification	Provision of good drainage in soils and avoidance of planting in water logged areas, crop rotation and proper field hygiene, including rouging out and burning of infected plants and weeding are cultural practices that can significantly reduce the impact of these foliar diseases on Finger millet. Application of pesticides such as mancozeb and cymoxanil based products as chemical options are also effective in managing these diseases.	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		

Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's.
Approaches to be used in Dissemination	Extension publications On-farm demonstrations Farmer field days. Farmer training Agricultural shows and exhibitions as well as farmer to farmer training. Farmer Field and Business Schools Agriculture Innovation Platforms
Critical/essential factors for successful promotion	Requires a strong partnership between technical personnel / extension and farmers. Availability of adequate funds to facilitate promotion. Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chain stakeholders.
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings.
	Individual Farmers farmer groups/CBO to participate in the implementation of this management practice for successful production of Finger millets.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Kericho, Bomet and West Pokot
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Finger millet production.
Challenges in dissemination	Change of mindset in favour of recommended practices maybe difficult to achieve. Where farmers would not afford the synthetic insecticides, IPM components will be limited to cultural and biological options hence, some damage might occur on the Finger millet crop. Applied and adaptive Research to develop, test, validate and release improved Finger millet varieties with resistance/tolerance to Cercospora leaf spot and Downy mildew A platform for interaction of Finger millet value chain stakeholders

Suggestions for addressing the challenges	Participatory approach in demonstrating the practice to farmers and economic analysis to convince them on costeffectiveness. Training farmers on how to apply IDM to suppress the foliar diseases Establish Finger millet Innovation Platforms
Lessons learned in up scaling, if Any	Proper adoption of IDM options for Finger millet foliar diseases can significantly increase yields and lower the total cost of production.
Social, environmental, policy and market conditions necessary for development and up scaling	The Management practice is socially acceptable and environmentally friendly.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh 50,000 per acre
Estimated returns	Ksh 500,000 per acre
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 chemicals than men</li> <li>• Women 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 exists 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 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 spraying the crop</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Reference Ravi Shankar, Seema Harsha, Raj Bhandary (2014). A Practical Guide to Identification and Control Finger millet Diseases TROPICA SEEDS PVT LTD   No 54, South End Road, 1st Floor, Nama Aurore Building, Basavangudi, Bangalore 560004 INDIA

<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 Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO (FCRC Muguga) – Dr David Lelgut KALRO (FCRC Kabete) – Harun Odhiambo
Partner organizations	County and private Agricultural Extension service providers CGIAR’s Agriculture-based NGOs and FBOs.

<b>2.6.11 TIMP name</b>	<b>Community rangeland rehabilitation to increase populations of natural enemies for pest management in Finger millet.</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Rangeland degradation due to human activity coupled with impacts of climate change. This has led to the decline in the population of natural pest enemies.
What is it? (TIMP description)	Rangeland rehabilitation consists of application of a range of TIMPs with the purpose of reclaiming the productivity of the rangelands. The ultimate goal is to reclaim the structure and functioning from the original system. Examples of TIMPs include multi-purpose agroforestry species, range reseeding and soil erosion control e.t.c.
Justification	The rangelands cover three quarters of Kenya and underpin the livestock and wildlife industries. However, rangeland communities have low development indicators and face several growing threats. Severe droughts, land degradation and land subdivision have resulted in disrupted livelihoods. This has enhanced the vulnerabilities of people living in these lands.
Counties where TIMPs have been promoted if any	-

Counties where the TIMPs will be upscaled	West Pokot, Baringo and any other County with agro-ecological zones suitable for Finger millet production
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, agro-pastoralists,
Approaches to be used in Dissemination	Demonstration, local FM Farmer Field and Business Schools Agriculture Innovation Platforms
Critical/essential factors for successful promotion	Timely disbursement of funds, Buy-in of technology from farmers and stakeholders Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Extension service providers (Public and private) to help in the dissemination. CGIAR's NGOs to link farmers to the market and farmer mobilization to lobby for changes in agriculture policies to favour the farmer.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	-
Counties where the TIMPs will be Upscaled	Baringo, West Pokot, Kericho and any other County with agro-ecological zones suitable for Finger millet production
Challenges in dissemination	Low or non-existent skill and technology High costs associated with technology installation vis-à-vis longer lead time for accrued benefits Limited supportive policies Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction of Finger millet value chain stakeholders

<p>Suggestions for addressing the challenges</p>	<p>County government to create an enabling policy and institutional environment for sustainable rangelands management</p> <p>Increased community awareness on the benefits of rangeland rehabilitation</p> <p>Lobby for increased funding for rehabilitation efforts</p> <p>Increase public investment to strengthen local governance for community-based rangeland rehabilitation through revival of traditional systems</p> <p>Strengthen awareness of the economic values of rangeland rehabilitation and develop markets- based incentives</p> <p>Strengthen livestock market linkages to reduce pressure on the range resources</p> <p>Establish Finger millet innovation platforms.</p>
<p>Lessons learned in upscaling, if any</p>	<p>There are greater benefits from rehabilitation, though this takes a longer time</p> <p>Community awareness on the benefits of rehabilitation increases support or buy-in</p> <p>Policies that support and enforce rehabilitation in communal and tenure systems are key for success</p>
<p>Social, environmental, policy and market conditions necessary</p>	<p>Supporting environmental policies</p> <p>Capacity building on rangeland rehabilitation TIMPs</p> <p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Partnership is important in dissemination and adoption and this can be facilitated through innovation platforms</p>
<p><b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b></p>	
<p>Basic costs</p>	<p>Depends on various factors like level of degradation and the TIMPs to be deployed</p>
<p>Estimated returns</p>	<p>Depends on various factors like TIMPs deployed and outputs from the rehabilitation efforts</p>
<p>Gender issues and concerns in development and dissemination</p>	<ul style="list-style-type: none"> <li>• Women 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>
<p>Gender related opportunities</p>	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youths in operating SMEs such as tree nurseries for income generation</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 chemicalsthan 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 developmentand 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	Employment opportunities exist for youths andthose recovering from drug abuse in operating SMEs such as tree nurseries for income Generation
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	This will depend on the level of degradation and the TIMP being deployed
F: Status of TIMP readiness (1-Ready for upscaling; 2-Requires validation; 3-Requires further research)	Requires further research
<b>G: Contacts</b>	
Contacts	Director Environment & Natural ResourcesKALRO Secretariat
Lead organization and scientists	KALRO, M. Okoti, J. Mwaura
Partner organizations	County government, PPP

### Research gaps

Assessment of rangeland ecosystem change

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

<b>2.6.12 TIMP name</b>	<b>Integrated Weed Management in millet production</b>
Crop management practices	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Different annual and perennial grass and broadleaved weed species combined with poor management of the weeds lead to yield losses and lack of profitability in millet cropping systems. The weeds compete with the crop for nutrients, soil moisture, space and sunlight which leads to reduction in yields and quality of the produce. Some key weed grass species include Crab sanguinalis ( <i>Digitaria spp.</i> ), goose grass ( <i>Eleusine indica</i> ), Craws foot ( <i>Dactyloctenium aegyptium</i> ) and difficult to control couch grass ( <i>Cynodon dactylon</i> ). Common broad leaved weeds include Sow thistle ( <i>Sonchus oleraceae</i> ), Black jack ( <i>Bidens pilosa</i> ), Gallant soldier ( <i>Galinsoga parviflora</i> ),

	<p>Goat weed (<i>Ageratum conyzoides</i>) and Thorn apple (<i>Datura stramonium</i>). Weeds such as <i>Amaranthus</i> species, Red pigweed (<i>A. retroflexus</i>), Sedges such as Yellow nutsedge (<i>Cyperus esculentus</i>), Wondering jew (<i>Commelina benghalensis</i>), Witchweed (<i>Striga hermonthica</i>) and Ragweed (<i>Parthenium hysterophorus</i>) are a challenge and difficult to control in millet growing fields or regions where they have succeeded because of their morphological and phenological characteristics.</p>	
		
		
		
		
	<p>Source: Hottensiah Mwangi</p>	
<p>What is it? (TIMP description)</p>	<p>Integrated Weed Management (IWM) is the management of weeds using two or more appropriate approaches including preventive, planting in a clean seed</p>	


	bed, use of mulch (biodegradable or synthetic), cultural, rotation, intercropping and chemical control depending on the weed types infesting the field.
	Cultural includes transplanting rather than direct planting, proper fertilization, irrigation, use of cover crops and plastic mulch to reduce weed populations. 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 2-3 weeks depending on environment, weeds present, rainfall or soils. Chemical control is where appropriate recommended herbicides are applied to control weeds following the label. The weed composition needs to be identified and the data used to implement timely and the best management approach. Proper identification of species will determine the best management option because one approach will be effective only on some species and not others. Use of two or more options could be appropriate for a clean millet field.
Justification	Millet growers in Kenya use inappropriate approaches to manage weeds due to limited knowledge on weeds and various methods of weed control. Although manual weeding can be effective for managing some weed species, it is time consuming and labour intensive, can be ineffective when done under wet conditions because weeds such as wandering jew ( <i>Commelina benghalensis</i> ) and purselanr ( <i>Portulaca oleraceae</i> ) get disseminated and are replanted through cuttings. Their regrowth becomes a big problem. A combination of herbicides integrated with cultural methods gives a promising option for timely and efficient weed control in millet cropping systems. There is therefore the need to apply more than one approach to manage the biodiversity of weeds.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension workers, Agrodealers
Approaches used in dissemination	Farmer field and business Schools (FFBS), Agricultural Innovation Platforms (AIP), Training workshops, Seminars, Meetings, Demonstrations and field days. Media (Online), manuals, pamphlets.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release IPM in millet varieties</li> <li>• A platform for interaction of millet value chain stakeholders</li> <li>• Promotion and training on integrated weed management (IWM).</li> <li>• Address environmental and safety concerns related to use of herbicides</li> <li>• Combine promotion with demos and field days with farmer groups and stakeholders on the effectiveness of various weed management options using FFSB approach.</li> <li>• Train users on appropriate and safe use of herbicide.</li> <li>• Train stakeholders on weed identification and dynamics in cropping systems.</li> <li>• While using pesticides farmers need to preserve pollinators.</li> </ul>
Partners/ stakeholders for scaling up and their respective roles.	Agrochemical companies, Agrodealers, Research partners (KALRO, County extension staffs, NGOs).
Agrochemical companies, Agrodealers, Research partners	

(KALRO, County extension staffs, NGOs).	
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any  Agrochemical companies, Agrodealers, Research partners (KALRO, County extension staffs, NGOs).	Busia County
Counties where TIMPs will be up scaled	All counties suitable for the crop including Western, Nyanza, Rift valley, & Central.
Challenges in development and dissemination  Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders, Low use of agronomic practices,  labour intensity, High cost of herbicides, Inadequate knowledge and information on which herbicides to use, when to use them and their	<ul style="list-style-type: none"> <li>• Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the technology</li> <li>• Labour intensity and 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> <li>• Myths on appropriateness of using herbicides</li> </ul>
Suggestion for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• Promotion of the technology/ product in the suitable areas conducting demos and field days and involvement of the stakeholder e.g. agro-chemical companies and agro-dealers.</li> <li>• Develop and disseminate information to various stakeholders.</li> <li>• Training on integrated approaches using available methods, including appropriate herbicides for millet, their persistence in different soil environment that can affect follow up crops in the rotation as a result of residues or carryover, safe use of the herbicides.</li> </ul>

Lesson 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>• IWM approach is more effective than use of one control method and is environmentally friendly.</li> <li>• Vegetables are produced in rotation with millet which may affect herbicide behaviour by reducing volatility and condensation phenomena and hence crop selectivity could be modified.</li> <li>• Excessive use of herbicides 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 concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Awareness creation through demonstrations and farmer field days help in adoption of IWM</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Train on understanding the working of IWM.</li> <li>• Have an environmental and safety plan when using herbicides.</li> <li>• Address the environmental and social concerns related to use of agrochemicals.</li> <li>• A functional agro-dealer network to supply the registered products when required by the farmers.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh
Estimated returns	KSH
Gender issues and concerns in development and dissemination	Since weeding for millet 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.
Gender issues and concerns in adoption and scaling up	Make all gender understand the benefits of IWM. Empower both men and women to make a judicious decision on IWM approach. Use of IWM technology can reduce drudgery from manual weeding and save time for other activities to women
Gender related opportunities	Labour is reduced therefore opportunities exist for women and youth to get in other economic activities including the production and marketing.
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	VMG groups could be having limitations in accessing the knowledge, resources and 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	Small holder farmers in Busia County.
Application guidelines for users	Anwar N.K. & Khan M. A and Sadiq M. (2008). Impact of Integrated weed Management on weeds and yield of maize. Pakistan J. Weed Scie Res. 14(3-4): 141-151. <a href="https://Research gate.net publications2410767441">https://Research gate.net publications2410767441</a> .
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation.
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO , Kabete Dr Momanyi Violet, Miriam Otipa, Dr Ruth Musila.
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

<b>2.6.13 Millet Intercropping System</b>	
<b>TIMP Name</b>	<b>Intercropping System in Millet production</b>
Categories (i.e. technology innovation)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addresses	Weed competition is a problem in millet cropping system. Most farmers prefer inter-cropping millet with other crops including legumes, cassava and vegetables in order to have better returns for their investment. Intercropping to control weeds requires specific spacing, right choice of crops depending on growth habit of the intercrop. This will require understanding of the optimal crop spacing and configuration, selection of varieties adapted to millet intercropping and adopting sequencing approaches that will maximize use of resources (water, nutrients and light) without causing competition and farmer lack this knowledge.
What is it? (TIMP description)	Innovative millet intercropping system is the growing of two or more crops in a field at the same time with an aim to enhance agricultural production and to obtain efficient land use by reducing the weedy area. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Farmer's common intercropping system involves planting crops such as vegetables (such as onions and kales) and cassava in between rows of millet or at the edge of plots. Innovative intercropping systems will involve arrangements that reduce weeds. More complex intercropping systems with more than 2 crops have also been tested.
Justification	Intercrops in middle rows can provide weed control between rows and reduce weed establishment in the field. Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. Poor intercropping results in

	<p>low yields attributed to competition for growth resources such as light and nutrients and may lead to increased infestation of pests and diseases. Millet does well when intercropped with legumes to mitigate the risk of total crop failure due to drought. Intercropping has advantages in regard to efficient land use. It can significantly increase total productivity due to better utilization of water, nutrients and solar energy (because of different rooting and canopy) as compared to mono-cropping. Intercropping system is a climate adaptation strategy in case of crop failure in mono-cropping and is therefore considered as one of the most dependable ways to sustain crop production. It is a risk mitigation strategy by farmers in light of the prevailing climate change.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	<p><b>Farmer field and business Schools (FFBS)</b>  <b>Agricultural Innovation Platforms (AIP)</b>          Training workshops, Seminars, Meetings          Promotional materials (posters/brochures/leaflets, manuals)          Demos and field days</p> 
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release intercropping system in millet varieties          A platform for interaction of millet value chain stakeholders          Conduct demos and the field days with farmers groups and stakeholders</p>
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company and seed dealers, Research organizations (KALRO, Egerton University, UoN)
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<p>Altitude highlands &gt; 1500 above sea level ie          Rainfall 400-6000mm annually          Temp 22-28o C</p>
Counties where TIMPs will be up scaled	
Challenges in development and dissemination	<p>Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders          Low use of the agronomic practices          Inadequate training and limited extension staff</p>
Suggestion for addressing the challenges	<p>Establish millet innovation platforms          Facilitation of training of county extension staffs          Contact demos and field days</p>

Lesson 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>• 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 innovation and its benefits.</li> <li>• There is need to adapt the intercropping innovations in all environments/AEZ</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ millet intercropping</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• A farmer learning platform is essential for training on how to deploy the innovative intercropping systems.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	<p>Complexity of the intercropping system can result in decreased labour, which could impact on the women who are key players during planting and weeding.</p> <p>Need to train, especially women, on how to implement the cover cropping systems.</p>
Gender related opportunities	Diversity and yield stability are a major win for the entire household.
VMG issues and concerns in development, dissemination, adoption and scaling up	<p>This is a knowledge intensive innovation especially the configurations. Training is key.</p> <p>Intercropping systems may impede mechanization of the production system.</p>
VMG related opportunities	<ul style="list-style-type: none"> <li>• System diversification and yield stability will increase food availability leading to food and nutrition security at household level.</li> <li>• Improved income from production and marketing of intercrops in systems gives diversified incomes.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Busia County
Application guidelines for users	Munisse P., Jensen BD., Quilambo OI., Anderson SB., and Christeiansen JL. (2012). Watermillet intercropped with Cereals under Semi arid Conditions: an on-farm study. Experimental Agric Vol., 48(3). 2012. Pp 388-398. Journal Cambridge University on-line Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2.	1. Ready for up scaling

Requires validation; 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	Dr Violet Momanyi, KALRO Kabete, Dr Hottensiah Mwangi
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

2.6.14 Mulching for weed management in millet production	
TIMP name	Mulching
Category (i.e. technology, innovation or management practice)	Technology
<b>Description of the technology, innovation or management practice</b>	
Problem addressed	<p>Weed infestation and competition for soil moisture and nutrients; and, Regulation of soil temperatures where necessary.</p> <div style="text-align: center;">  <p><i>Starbur(Acanthospermum hispidum) and Double thorn (Oxygonum sinuatum). Source: Hottensiah Mwangi</i></p> </div>
What is it? (TIMP description)	<p>The practice of covering the soil/ ground with natural or or synthetic materials. Mulches can effectively control germination of weeds at or near the soil surface. The two types of mulches are: biodegradable or natural mulches. Biodegradable include straw, grass and dead leaves. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used to control weeds in millet fields.</p> <p>Organic mulches suppress weeds; retain moisture in the soil; keep the soil cool; and help improve soil fertility (since the mulches decompose) and improve microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weeds and weed seeds, retain soil moisture and controls diseases. Inspect and pull out emerging weeds timely.</p>
Justification	Black polythene prevents light from reaching the small weeds and seed germination. Organic mulching (straws and dry grass) in between rows have

	added benefits other than minimizing weed infestation. It facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil structure directly by preventing impact of raindrop and indirectly by promoting biological activity. Although a common farmer may not afford, synthetic mulches are easy to obtain and apply, and are reusable.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Farmers	
Approaches to be used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Farmer field Business schools On-farm demonstrations during farmer field days Training in workshops
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release mulching technology in millet varieties A platform for interaction of millet value chain stakeholders Availability of plant or crop residues for organic mulches. Size of the land. Competing uses of crop residues. Type and availability of the crop residues Cost and availability of synthetic materials Disposal of material after use.
Partners/stakeholders for scaling up and their roles	Community farmer groups; play coordination role for ease in problem identification and dissemination
County government extension services; Provide link with farmers	
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Kenya.
Current extent of reach	Available and practiced in different crop value chains
Counties where TIMP will be promoted	Where millet is a priority value chain.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the agronomic practice</li> <li>• Labour intensity and availability of mulching materials</li> <li>• Lack of enough plant and crop residues due to competing uses of organic mulches.</li> </ul>

	<ul style="list-style-type: none"> <li>• Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.</li> <li>• Be aware of small tears and rips which will allow weeds emergence through plastic mulches including around the holes. Purple and yellow nutsedge and oxalis may penetrate mulches as early as six days after transplant in plastic mulches.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• Crop diversification to increase availability of organic mulches.</li> <li>• Establish and follow a good integrated weed management control program for the particular millet varieties.</li> <li>• Monitor for any tears /rips and pull out any weeds without allowing them to take over.</li> <li>• Adapting alternative mulching materials like high absorbance polymers.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• There is need to adapt to alternative mulching technologies in addition to use of organic materials like straws dry leaves, and dry grass.</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>• Increased productivity will provide supply to the markets</li> <li>• Availability of supporting frameworks/ policies.</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 varieties of millet.
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere. Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is labour intensive for VMGs, hence its adoption and scaling up is a challenge.
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.

<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	User guidelines are dependent on value chain. 1.Plant clean millet seeds in clean seed bed 2. Apply mulch between the rows of millet rows.  Mulch management Hand pull or kill weeds that grow out of the mulch.
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Ready to use.
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Dr Violet Momanyi.
Partner organizations	County governments Public-Private-Partnerships

<b>2.6.15 Herbicide (Chemical) Weed Control in millet production</b>	
TIMP Name	Herbicide (Chemical) Weed Control
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Competition from weeds prevents maize getting nutrients, soil moisture and space resulting to weak and stunted growth leading to reduced final yields. This poses a problem to young maize. Amount of damage on young maize depends on weed density and diversity, stage of weed growth and environment.



Young weed infestation in finger millet  
Source: Lusike Wasilwa

Grass weeds include couch grass (*Cynodon dactylon*) and goose grass (*Eleusine indica*) while broadleaved weeds include Amaranths species such as red pigweed (*A. retroflexus*), black jack (*Bidens pilosa*), (*Datura stramonium*). Wandering jew (*Commelina* species), nutsedges (*Cyperus* species) and purslane (*Portulaca* species) are more challenging because of re-growth from cuttings after weeding. Parthenium and Striga are equally a major problem and difficult to control in millet. The weed problem is aggravated by wrong timing and poor method of weed control activities.

What is it? (TIMP description)

Chemical weed control refers to any technique that involves the application of herbicides to weeds or the soil to control the germination and growth of the weed species.

Herbicide weed control is a technology that requires intensive knowledge on herbicides mode of action, the selective ones for maize, conditions necessary for application to be effective, type of soil, when to apply and how application is done. Use only recommended herbicides listed by Pesticide Control Board.



Application of a pre-emergent herbicide on the soil  
Source: Hottensiah Mwangi



Application of a pre-emergent herbicide to kill weeds after manual tillage with a jembe  
Source: Violet Momanyi

Justification

Appropriate use of herbicides (applications done at the right time and rate indicated on the label) reduces drudgery and allows timely weed control. Several pre-emergent and post-emergent selective herbicides are registered for control of annual and perennial broad leaved weeds in millet. Pre-emergent

	herbicides include Lasso atrazin (both narrow and broad leaved weeds) and post-emergent herbicide 2,4-D (only broad leaved weeds) at rates indicated on the label will effectively control weeds. Post emergence herbicides are applied in middle rows using a hood where need be to avoid or using a wick crop injury. Proper calibration of sprayer is critical to maintain correct sprayer pressure, flow rate from each nozzle and tractor speed or walking speed.
Region promoted	Limited use of herbicide among small scale farmers in millet
Counties where TIMP will be upscaled	Herbicide weed control can be up-scaled in all the areas where millet is being grown.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	<ul style="list-style-type: none"> <li>Farmer field and business Schools(FFBS)</li> <li>Agricultural Innovation Platforms (AIP)</li> <li>On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of herbicides.</li> </ul>
Most effective approach	<ul style="list-style-type: none"> <li>On-farm experimentation and larger plot effect demonstrations.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Applied and adaptive Research to test, validate and release herbicide weed control in millet varieties</li> <li>A platform for interaction of millet value chain stakeholders</li> <li>Capacity building and training on safe use of herbicide for all users</li> </ul>
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>FIPs (Farmer Input Promotion) for promotion.</li> <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>	
Current extent of reach	Validation of these herbicides needs to be done under different agro-ecological zones and soils before recommendations are given to the farmers.
Challenges in dissemination	<ul style="list-style-type: none"> <li>Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>Low use of agronomic practice</li> <li>Limited knowledge and information and low literacy levels among the farmers or sprayers to read and interpret label instructions.</li> <li>Capacity building is required to impart knowledge and skills in safe use and application of herbicides.</li> <li>The farmers need to understand the proper use and application of herbicides to avoid buying inappropriate herbicides and minimize health, environmental and social hazards.</li> </ul>

Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of herbicides. This 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 farmer empowerment and guidance on safe use of herbicides.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology- chemical weed control</li> <li>• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Sensitization of communities on alternative methods of weed control and appropriate use of herbicides is vital.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Herbicide cost plus labour is approximately KSH 10,000 per acre
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Need to sensitize both men and women on value of crop losses caused by weed competition
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	Women and children are the main sources of labour for this crop. Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities.
Gender related opportunities	Women stand to benefit in increased production due to timely operations, increased yields and sales.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to benefits from improved technologies. Thus, affirmative action is required to promote the millet for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Timely operations will lead to enhanced production by VMGs.
VMG related opportunities	Use of herbicides will improve weed management leading to increased productivity, increase availability of millet for consumption which will

	improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
<b>E: Case studies/profiles of success stories</b>	
Success stories	.Large scale farms in Kenya
Application guidelines for users	Rational use of herbicides. Eco friendly Weed Control options for Sustainable Agriculture. Science Alert. Review article. Scialert.net/fulltext/? Herbicides. NORTH CALORINA STATE EXTENSION. <Https//content.ces.ncsu.edu>  Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
F: Status of TIMP Readiness (1. Ready for up-scaling; 2.) Requires validation; 3. Requires Research )	2. Requires validation 3. Requires research
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MoALF in Counties, Chemical companies.
<b>2.6.16 Solarisation Bed for Weed Control in millet</b>	
TIMP Name	Solarisation Bed for Weed Control
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Competition from weeds in organic growers millet systems causes weak and stunted growth in babycorn and green millet. Weeds poses a problem around young millet seedling during the critical period of weed management. This depends on weed density, stage of growth and environment. The grass weed problems include Sudan grass ( <i>Sorghum halepense</i> ), goose grass ( <i>Eleusine indica</i> ) and difficult to control couch grass ( <i>Cynodon dactylon</i> ). Broadleaved weeds include amaranths species such as Red pigweed ( <i>A. retroflexus</i> ), black jack ( <i>Bidens pilosa</i> ), <i>Acanthospermum hispidum</i> ) and Double thorn ( <i>Oxygonum sinuatum</i> ). Broad leaved weeds that are difficult to control include wandering jew ( <i>Commelina species</i> ), purslane ( <i>Portulaca oleraceae</i> ) and which weed ( <i>striga species</i> ). Controlling nutsedges such as ( <i>Cyperus rotundus</i> ) is also more challenging. The weed problem is aggravated by herbicide resistance, weed shift, threats to environment and wrong timing and use of poor methods of weed management practices.
What is it? (TIMP description)	Solarisation is a method where you use transparent polythene films that increase soil temperatures by 10 <sup>0</sup> C or more than atmospheric to kill weed seeds and seedlings. Basic phenomena is building up of lethal high temperatures in the soil where most dormant and viable seeds are present. The Mechanism is

	mainly breaking dormancy of weed seeds, solar scotching of emerged weed seedlings and direct killing of weed seeds by heat. The mechanism can increase soil temperature by 8-12 °C over non mulched soil. Rhizomes of perennial weeds may be killed if not deeply buried. Effectiveness is specific to species and also depends on length of period of heating.
Justification	Solarization for two consecutive years is successful in controlling perennial weeds such as sedges. Solarization with 0.05mm T Polythene sheets 40 days is effective in controlling weeds than use of 0.01mm polythene and takes shorter time duration. This is a good ecological and environmentally friendly method that is sustainable for small scale organic growers.
Region promoted	The Netherlands
Counties where TIMP will be upscaled	Solarization weed control can be upscaled in all the areas where millet of high value are being grown especially for organic farmers.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on how to use solarization.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release solarisation bed technology weed control in millet varieties</li> <li>• A platform for interaction of millet value chain stakeholders</li> <li>• Development of the agronomic practice for millet</li> <li>• Capacity building and training on use of polythene and solar power.</li> </ul>
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>• FIPs (Farmer Input Promotion) for promotion.</li> <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>	
Current extent of reach	Validation of these solarization needs to be done before recommendations are given to the farmers.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the agronomic practice</li> <li>• Labour intensity</li> <li>• Limited knowledge and information and low literacy levels among the farmers.</li> </ul>

	<ul style="list-style-type: none"> <li>• Capacity building is required to impart knowledge and skills in appropriate use and application of solarization.</li> <li>• The farmers need to understand the proper use and application of solarization to avoid buying inappropriate polythene and minimize health, environmental and social hazards.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of solarization. This help in reaching the farmers with the information.</li> <li>• Polythene disposal should be done carefully to avoid environmental, health and social hazards.</li> <li>• Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on reuse and polythene disposal.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology of Solarisation bed for weed control</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms.</li> <li>• Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Sensitization of communities on alternative methods of weed control and appropriate use of polythene is very necessary.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b></li> </ul>	
Basic costs	<ul style="list-style-type: none"> <li>• Solarization to control weeds is cheaper than manual weed control because it requires less labour and achieves timely weed management.</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Not yet estimated</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Need to sensitize both men and women on value of crop losses caused by weed competition</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and children are the main sources of labour for this crop. Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased production due to timely operations, increased yields and sales.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to benefits from improved technologies. Thus, affirmative action is required to promote the solarization for the VMGs including value addition aspects.</li> </ul>



VMG issues and concerns in adoption and scaling up	Timely operations will lead to enhanced production by VMGs.
VMG related opportunities	Increased production will lead to increased consumption of baby corn /green millet of high value which are high in antioxidants hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
<b>E: Case studies/profiles of success stories</b>	
Success stories	Pakistan
Application guidelines for users	Muhammad A.K.etal.,(2012). An approach to organic weed management. <i>J. Communications soil science and plant analysis</i> .43:1847-60. DOI:10.1080/DOI03624  Ali El Keblawy and Hamadi F.A (2009). Assessment of the differential response of weeds to soil solarization by two methods (2009). Research gate.net publications-230177258. <i>J. Weed biology and Management</i> . Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	2. Requires validation 3. Requires research
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MoALF in Counties, Chemical companies.

<b>2.6.17 Stale seed bed for Weed Control in millet</b>	
TIMP Name	Stale seed bed for Weed Control
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Competition from weeds prevents millet getting available resources and can cause weak and stunted growth. This poses a problem around young millet just starting. This depends on weed density and diversity, stage of weed growth and environment. The grass weed problems include crab sanguinalis ( <i>Digitaria sanguinalis</i> ) and goose grass ( <i>Eleusine indica</i> ) and couch grass which is difficult to control. Broadleaved weeds include amaranths species such as the Red pigweed ( <i>A. retroflexus</i> ), Datura ( <i>Datura stramonium</i> ), black jack ( <i>Bidens pilosa</i> ) and witch weed (Striga) species Weeds whose control is challenging include: the nut sedges wandering jew (Commelina species), parthenium and stiga species.The weed problem is aggravated by wrong timing and poor method of weed control activities.

What is it? (TIMP description)	Stale seed bed “false” is where seeds are allowed to germinate by rainfall or wetting and killing them (1-2 flushes of the weeds) before sowing the Clean certified millet variety seeds. They are killed using glyphosate, sulfosate and glufosinate. At this stage shallow or use of non-residue paraquat may be used to destroy dense flush young weed seedlings. This is followed by sowing the selected baby corn. Problem is most weed seeds that have the potential to develop are those where there is adequate soil moisture and temperature of 50 <sup>0</sup> F at a depth of 2 inches. Several passes are made in soil with roto Spike tooth hallow is very useful implement for destroying the emerging weeds during preparation of stale beds. Then weed seeds allowed to germinate as weather permits. Then the weeds are dessicated or plowed.
Justification	With sound knowledge of weed phenology and other factors like temperature, irrigation and humidity at the local level it is possible to predict when certain weeds will raise problems in millet seedbed.
Region promoted	
Counties where TIMP will be upscaled	Stale bed weed control can be upscaled in all the areas where baby corn and green are being grown.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Training workshops, Seminars, Meetings On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on how to use stale bed.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release stale seed bed for weed control in millet varieties A platform for interaction of millet value chain stakeholders Capacity building and training on use of polythene and stale bed
Partners/stakeholders for scaling up and their respective roles	Public and private partners –[MOALF&I) for extension, Chemical companies for back stopping. FIPs (Farmer Input Promotion) for promotion. Farmer Groups for activity implementation and promotion. Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply. Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Validation of these stale beds needs to be done before recommendations are given to the farmers.
Challenges in dissemination	Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Low use of the technology Labour intensity

	<p>Limited knowledge and information and low literacy levels among the farmers. Capacity building is required to impart knowledge and skills in safe use and application of stale beds.</p> <p>The farmers need to understand the proper use stale beds</p>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of stale beds. This help in reaching the farmers with the information.</li> <li>• Polythene disposal should be done carefully to avoid environmental, health and social hazards. Liaise with the</li> <li>• Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on use of stale bed.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology- Stale seed bed</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.</li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of stale beds is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Stale bed use is cheaper than manual weed control because it requires less labour and achieves timely weed management.
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Need to sensitize both men and women on value of crop losses caused by weed competition.
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	Women and children are the main sources of labour for this crop. Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities.
Gender related opportunities	Women stand to benefit in increased production due to timely operations, increased yields and sales.
VMG issues and concerns in	Due to prejudice associated with their social status, VMGs are excluded from access to benefits from improved technologies. Thus, affirmative action is required to promote the millet for the VMGs including value addition aspects.

development and dissemination	
VMG issues and concerns in adoption and scaling up	Timely operations will lead to enhanced production by VMGs.
VMG related opportunities	Increased production will lead to increased consumption of which are high in antioxidants hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs.
<b>E: Case studies/profiles of success stories</b>	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	Requires validation and more research
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MoALF in Counties, Chemical companies.

2.6.18 Mechanical weed control in millet	
<b>TIMP Name</b>	<b>Mechanical weed control in millet</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<p>Hand weeding manually is labour intensive, back breaking and drudgery. It is commonly done late when it has competed and taken over the millet crop</p> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;"> <span style="margin-right: 100px;">Laborous hand weeding</span> <span>Clean field hand weeded</span> </p> <p style="text-align: center;"> <span style="margin-right: 100px;">Soource: Lusike Wasilwa</span> <span>Soource: Lusike Wasilwa</span> </p>
What is it? (TIMP description)	Prepare land well using hand tools to get a weed free seedbed. Sow clean certified seeds into a weed free field. The sowing is done in rows to facilitate inter row weeding.

Timely weeding is most effective at 2-3 weeks after sowing. Monitor weeds weekly and do a second weeding weed 2 to 3 weeks later.



*Clean millet seed bed, rows prepared manually to facilitate timely inter-row weeding when weeds emerge. Source: Hottensia Mwangi*

Avoid weeding delay that may result to weed take over with consequent severe competition with the millet. Use appropriate tools for weeding to avoid shock-stress on millet due to disturbance and root damage because the young millet plants are very sensitive.

The intra row weeds can be removed by hand pulling.


#### Justification

Weeds if not controlled will take over, win the competition and and cause yield losses. Deep tilling maximizes soil disturbance and bring dormant weed seeds to the surface for germination. Some species are known to be deeply buried in soil for the year before favourable conditions allow germination.



Clean field, weeded manually. Source: Lusike Wasilwa

By tilling the farmer increases the chances for weed seed germination. The fine soil allows weed seed to grow rapidly by allowing the seed to open and roots to spread easier than compact soils. These emerged weeds can then be destroyed by mechanical weeding to get a clean crop that will give good yields.

Region promoted	The Netherlands.
Counties where TIMP will be upscaled	All counties growing millet.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers and Agricultural extension officers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.</li> </ul>
Most effective approach	<ul style="list-style-type: none"> <li>• On-farm experimentation and larger plot effect demonstrations.</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 mechanical weeding in millet varieties</li> <li>• A platform for interaction of millet value chain stakeholders</li> <li>• Participatory Implementation, stakeholder sensitization.</li> </ul>
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>• 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>	
Current extent of reach	Limited research done on gender responsive weeding implements.
Challenges in dissemination	<p>Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</p> <p>Labour intensity</p> <p>Low use of agronomic practices</p> <p>Labour intensity</p> <p>Appropriate implements are not readily available in the market such as subsoilers.</p>  <p>Subsoiling using a subsoiler for minimum soil disturbance Source: Hottensiah Mwangi</p>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• Work with Jua Kali industries for fabrication of appropriate implements.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Access and use of appropriate weeding tools (technology) will provide timely weed control with reduced drudgery to enhance crop production.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Sensitization of communities on the mechanical weed management practices for sensitive millet young plants.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Basic costs include weeding, seeds and tool which approximately 20,000 per acre for ordinary millet.
Estimated returns	KSH 2,200,000/ per acre green depending on market.
Gender issues and concerns in development and dissemination	Need to sensitize both men and women on value of weed losses caused by weeds and timely weed control
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	Women and children are the main sources of labour. Increased workload of weeding is likely to directly impact on women and school going children.
Gender related opportunities	Women stand to benefit in increased production as this is a nutritious food crop which will improve the diets. Sale of extra millet improve the household income. Also weeding labour will be reduced.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Timely operations will lead to enhanced production by VMGs.
VMG related opportunities	Increased production will improve food and nutrition security and economic empowerment of VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories	Tharaka nithi.
Application guidelines for users	ToT Manuals to include weed management TIMPs.
<b>F: Status of TIMP Readiness (1. Ready</b>	1. Ready for up-scaling

for up-scaling; 2. Validation 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Dr Violet Momanyi.
Partner organizations	MoALF in Counties


<b>2.6.19 Crop Rotation in Millet</b>	
<b>TIMP Name</b>	<b>Crop Rotation in Millet 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	Diverse weed species and rich weed seed banks in millet cropping systems contribute to high crop losses due to competition with the crop for growth resources such as nutrients and water.
What is it? (TIMP description)	<p>This is the growing of different crops in succession on a piece of land to avoid exhausting the soil and to control weeds, pests, and diseases. A good successive weed control strategy starting with a crop rotation schedule incorporated for optimal millet production and yield. Land is divided into a number of distinct areas where the crops will be rotated every year. Keep plants of same type together. eg Millet – maize – sorghum. Millet is a heavy feeder and should follow legumes. Rotation adds diversity to the cropping system, increases sustainability, of the system and provides the foundation of long term weed management.</p> <p>Sow certified millet seeds in rows a clean weed free seed bed. Rotation is the most critical time for obtaining good crop weed control but emphasize before making decision should be on environment, weeds present, time of year, crop rotation, irrigation methods and herbicide cost. Good rotation is achieved by combining cultural and herbicide weed management strategies. Two options</p> <p>1.) Form beds well before planting. Flush growing weeds . Knock them down with a recommended post emergence herbicide or shallow weeding. 2.) Form beds just before planting, remove any emerged weeds or use pre-plant herbicides such as (glyphosate, paraquat and diquat) depending on weeds present, stage of weed growth and herbicide cost. You can start by applying appropriate herbicide targeting specific weeds on your land eg Glyphosate at a rate of 100-300ml in 20L water to control emerged grasses and broadleaved weeds. Older weeds need a higher dose. Use hooded spray to control weeds in middle of rows. Millet. When weeds are small this reduces weeding costs.</p> <p>The most effective management must be made before millet is planted.</p> <p>Detailed weed information (annual broad leaved or grasses) recorded or maps kept over time will help improve management decision in millet crop rotation.</p>

Justification	Planting a wide variety of crops with varied characteristics reduces the likelihood that specific weed species will become adapted to the system and become problematic. The successive of rotation systems for weed suppression appears to be based on the use of crop sequences that employ varying patterns of resources competition, allelopathy interference, soil disturbance and mechanical damage to provide an unstable and frequently inhospitable environment that provides the proliferation of a particular weed species. Correct timely Crop Rotation minimizes weeds population in current millet crop and reduces weed seed banks so there is less future infestations. Different crops grown in rotation break the cycle of weeds. The diversity of weed management strategies used for different crops also increases weed diversity and reduces prevalence of problem weeds that can build over time. Optimal timing for Cultural operations is most effective for weeds management because too early weeding does not achieve full benefits; since there is time for further weeds to germinate before canopy closes. Planting dates are important. The most effective management must be made before crop is planted and this is taken care of when planning the rotation. Perennial weeds should be controlled during non- crop periods.
Region promoted	Areas where millet are grown eg Busia, Kakamega, Nyanza.
Counties where TIMP will be upscaled	All regions suitable for growing millet
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP) On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release rotation practice in millet varieties A platform for interaction of millet value chain stakeholders participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	Public and private partners –(MOALF&I) for extension, Jua Kali artisans Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Limited research done on appropriate rotations for millet systems.
Challenges in dissemination	Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Low use of the technology Small farms due to family subdivisions Labour intensity Rotation schedules for millet not readily available.

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish millet innovation platforms</li> <li>• Information dissemination on the practices</li> <li>• Promotion of the technology in the suitable areas</li> <li>• Work with farmers to validate known schedules from other researchers or countries in different millet growing regions.</li> </ul>
Lessons learned	<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>• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Use of appropriate crop rotation will provide timely weed control which will enhance crop production.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Sensitization of communities on the crop rotation practices in weed management</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Basic cost of crop rotation for millet farmers: hand weeding expensive in short run but longer benefits in reduced seed banks.</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Not yet estimated</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Need to sensitize both men and women on value of crop rotation for timely weed control and reduction of weed seed banks.</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and children are the main sources of labour. Reduced workload of weeding is likely to directly impact positively on women and school going children.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased production as millet is a nutritious food crop which will boost health. Sale of extra produce improve the household income.</li> <li>• Also weeding labour will be reduced.</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the millet crop for the VMGs including value addition aspects.</li> </ul>
VMG issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Timely operations will lead to enhanced production by VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased production will improve food and nutrition security and economic empowerment of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Millet farmers in highlands Counties and Coast region.
Application guidelines for users	Production manuals to include crop rotation weed management TIMP

F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Validation 3. Requires further research)	2. Ready for validation
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	ICRISAT Nairobi; MoALF in Counties

### 2.6.20 Safe Use of herbicides

<b>TIMP Name</b>	<b>Safe Use of herbicides in millet 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	Excessive herbicide application to crops and the soil, use of herbicides for spraying crops without wearing the right protective clothing, storage of herbicides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, and use without following the guidelines provided on the labels (eg rate and Pre-Harvest Interval), disposal of expired herbicides and empty containers. inadequate enforcement of global and national policies and regulation on use of pesticides.
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 and misuse use of pesticides are very common in most of the areas where maize is grown, they are not documented. There

Full protection while spraying is recommended. Source: Hottensiah Mwangi

	<p>have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users to be made aware of the best practices that should be used when handling herbicides. There has been reports of increase of chronic diseases in human beings resulting from pesticide exposure.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Watermelon producers
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, Pesticides spray Demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and employ safe use herbicide application in maize varieties A platform for interaction of maize value chain stakeholders Development of agronomic practices for cabbage Collaboration between all partners, willingness of farmers to adhere to proper guidelines. Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for maize production, KALRO and Universities to develop the technologies and conduct ToTs. AAK, PCPB, KEPHIS.
<b>C: Current situation and future scaling up</b>	
Counties where technology is already being promoted if any	To be selected
Counties where TIMPS will be up scaled	To be selected
Challenges in dissemination	Lack of millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Low use of technology Labour intensity and requires skilled man power Change of mindset in favour of current practices maybe difficult to achieve. Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of herbicides. Use of banned pesticides from neighboring countries Inadequate capacity by farmers and agrochemical companies to dispose herbicides (pesticides) properly
Suggestions for addressing the challenges	Establish millet innovation platforms Capacity building and sensitization forums for both farmers and agro dealers using participatory approach.

	<p>Formation of youth spray teams.</p> <p>Establishment of aggregation centres for pesticide containers</p> <p>Establishment of training of Extension staff and lead farmers as TOT.</p> <p>Increase surveillance along the border points and enforce the laws.</p>
Lessons learned in upscaling if any	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</p> <p>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.</p> <p>The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of herbicides in some areas.</p>
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	KES - per acre
Estimated returns	KES - per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<p>Technology is not safe for use by expectant women and the physically challenged individuals because of its hazardous/dangerous nature.</p> <p>Herbicides and protective gear are expensive and most women may not afford them.</p> <p>Lack of knowledge by men and women on the dangers of herbicides especially on storage and disposal.</p> <p>Low levels of illiteracy and inability to read and interpret the content of the herbicide labels especially on re-entry period after spraying and PHI. This can cause herbicides poisoning to get into contact.</p>
Gender related opportunities	<p>Formation of spray teams by men</p> <p>Formation of surveillance/scouting groups by women</p>
VMG issues and concerns in development, dissemination, adoption and scaling up	<p>These are dangerous products that may not be handled by vulnerable groups.</p> <p>Herbicides are expensive for most youths and physically challenged groups that may not utilize them.</p>
VMG related opportunities	<p>Safe use of herbicides practice can easily be undertaken by the youth as an enterprise by forming Spray teams in the wards in each county.</p> <p>Youths to offer spray calibration services to farmers as an enterprise.</p>

	<p>Youths to help in the collection of pesticide containers and assist in the incineration processes by AAK.</p> <p>Youth to own and operate agro chemicals that stock right pesticides and offer advisory services to farmers at the agrovet shops</p>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>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.</p> <p>Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms.</p> <p>Safe use of Pesticide campaigns by AAK, PCPB, KALRO and MOLF.</p>
Application guidelines for users	<p>Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Plant doctors using the CABI modules, manuals and establish Plant Clinics in the target counties. Develop and equip the Plant Doctors and youth spraying teams with pest decision guidelines, manuals, brochures developed by KALRO and CABI as reference material</p>
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling
<b>F: Contacts</b>	
Contacts	<p>KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org</p>
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi.
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities


## 2.7 Harvesting and Postharvest Management

<b>2.7.1 TIMP Name</b>	<b>Maturity and harvesting Techniques</b>
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	Losses due to immature harvesting and inappropriate harvesting modes
What is it? (TIMP description)	This is a management practice involving identification of maturity indices, pre-harvest operations and actual harvesting procedure.

	Millet grains should be harvested as soon as they are physiologically mature. Late harvesting may lead to lodging leading to losses and grain deterioration due to rapid changes in temperature and humidity. In hand harvesting the panicle is cut from the standing stalk at about 16-20% moisture content and the stalks are used as animals feed.
Justification	Incorrect timing of harvesting and inappropriate harvesting methods leads to losses of millet: Harvesting immaturity of the crop, usually results in lower yields, and high proportion of immature seeds, poor grain quality and more chances of pest infestation during storage. Delay in harvesting of millet results in shattering of pods and other losses caused by birds, rats, insects, etc.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	On farm and on station demonstrations Agricultural exhibitions Field days Agricultural shows Extension officers Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to harvest quality crop. Application of timely harvesting and harvesting methods. Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
Partners/stakeholders for scaling up and their roles	Public and private partners –[MOALF&I) for extension, ICRISAT for technical backstopping and promotion; FIPs (Farmer Input Promotion) for promotion Farmer Groups for activity implementation and promotion Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply. Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Kitui, Coastal regions
Counties where TIMP will be up scaled	All finger millet growing counties – Busia, Kakamega, Bungoma, Siaya, Kisii, Nyamira, Migori, Kericho, Bomet, West Pokot.
Challenges in dissemination	Limited knowledge on maturity indices on maturity indices
Suggestions for addressing the challenges	Capacity building on millet harvesting and appropriate harvesting methods
Lessons learned in up scaling if any	Create awareness on benefit of appropriate harvesting stage and harvesting modes

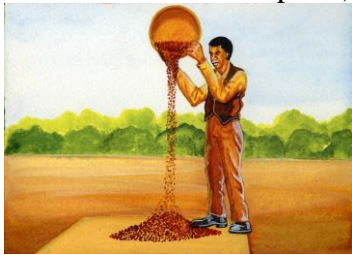
Social, environmental, policy and market conditions necessary for development and up scaling	Opportunities for increased returns due to appropriate harvesting methods
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet done
Estimated returns	Not yet done
Gender issues and concerns in development, dissemination, adoption and scaling up	The adoption of management practices that reduce post-harvest losses lead to increased output, hence food security and income for the families, and especially women, the main producers Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Reduced losses hence increased income for women, VMGs and other producers
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 finger millet
VMG related opportunities	The innovation can improve food and nutrition security and increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Capacity building in Kitui, Machakos and Mbeere South
Application guidelines for users	Millet extension training manual Postharvest handling leaflets
<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	KALRO Chrispus Oduori, Nungo, R, Opole R ,Maina FW, Kimani P, Ketiem P, Omondi S.P., Ombakho, Gathambiri C.
Lead organizations and scientists	Centre Director, KALRO-Kisii P.O. Box 523-40200, KISII; e-mail address: chrispus.oduori@kalro.org; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ ICRISAT Nairobi, P.O. Box 39063, NAIROBI, Kenya. Tel +254 20 7224550; e-mail: icrisat.nairobi@cgiar.org
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – where finger millet is grown

<b>2.7.2. TIMP Name</b>	<b>Reducing Postharvest Yield and Quality Losses in Finger Millet Production</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield and quality losses resulting from postharvest operations

<p>What is it? (TIMP description)</p> 	<p>This TIMP discusses management of losses after harvesting finger millet. These operations comprise harvesting, harvest transportation, drying, threshing, winnowing, grain transportation, and storage. Before finger millet is harvested, farmers' experiences some losses caused by birds and other field pests (rodents or wild/domesticated animals) and shattering. Other losses emanate from early harvesting before its maturity and harvesting during rainy season. In fact, finger millet planted early is more vulnerable to losses than late planted millet due to birds' attack. Generally, up to 15 percent of the losses is observed for early planted millet.</p> <p>Traditionally, after harvesting, finger millet is stored in granaries in form of ears or panicles. Thereafter, the women pound/thresh them by hand whenever required. During this manual threshing, large amounts of yield are lost as operation takes place on the ground and poultry eat quite a bit during airing threshing and winnowing. Therefore, there is need for farmers to understand the importance of managing key postharvest operations in finger millet as an adaptive measure for reduced yield and quality losses.</p>
<p>Justification</p>	<p>Reduction of quantity and quality losses directly impacts on household food security, incomes and resilience from the shocks of climate change to agricultural sector. Adoption of this TIMP would increase the amount of finger millet available for human consumption and enhanced food security, a growing concern caused by increased climate variability. Therefore, farmers need to understand measures of managing various operations from harvesting to storage.</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> <li>- Extension Agents (Public and Private)</li> <li>- Research organizations and universities</li> <li>- CGIAR's</li> </ul>
<p>Approaches to be used in dissemination</p>	<ul style="list-style-type: none"> <li>- Extension publications</li> <li>- On-farm demonstrations</li> <li>- Farmer field days</li> <li>- Farmer training</li> <li>- Agricultural shows and exhibitions</li> <li>- Farmer to farmer training</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>- Strong partnership linkages</li> <li>- Need for farmer involvement – This helps generate locally specific techniques, solutions and experiences suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster.</li> <li>- Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted</li> </ul>
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the dissemination</li> </ul>


	<ul style="list-style-type: none"> <li>- Lead farmers</li> <li>- NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers</li> <li>- County governments –Help in the dissemination of the technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Western Kenya counties of Busia, Bungoma, and Kakamega
Counties where TIMPs will be upscaled	Kericho, Bomet, and West Pokot
Challenges in dissemination	Farmers may slowly adopt due to inadequate awareness on existing appropriate innovations for managing the specific losses. Bird menace in the field remains a big limitation for large scale production, lack of harvesting equipment and threshing
Suggestions for addressing the challenges	Training and demonstration on the various existing innovations (threshing, storage) and other management practices.
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Understanding varietal characteristics and their susceptibility to losses. Farmers need clear linkage for precautionary measures</li> <li>- Management of birds' damage and other rodents in the field is critical. Although there exist no formal technologies, practical workable approaches need to be shared (multiple approaches required)</li> <li>- The resilience and importance of millet in the projected climate scenarios needs to be strengthened. Finger millet is highly resilient to warmer environment and water stress.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices</li> <li>- Product diversification can enhance the social wellbeing of the community</li> <li>- Market is able to absorb increased supply of grain</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	- Not yet estimated
Estimated returns	- Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- The adoption of management practices that reduce post-harvest losses lead to increased output, hence food security and income for the families, and especially women, the main producers</li> <li>- Setting of traps may create income generation opportunity for the youth</li> </ul>
Gender related opportunities	- Reduced losses hence increased income for women, VMGs and other producers
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 finger millet

VMG related opportunities	The innovation can improve food and nutrition security and a window for increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-Farmers in western Kenya counties of Busia, Kakamega, Bungoma, Kisii, Migori, and Nyamira have embraced most of this practice and have reduced losses and produce quality grain without contaminants.
Application guidelines for users	Manual and fact sheet developed for users
<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	The Centre Director, KALRO-Kisii; P.O. Box 14733-00800 Nairobi Email: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> Phone: 0727624471
Lead organization and scientists	KALRO-Kisii, Chrispus Oduori, Nungo, R, Opole R ,Maina FW, Kimani P, Ketiem P, Omondi S.P., Ombakho G
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> <li>- Help in the dissemination of the technology,</li> </ul>

<b>2.7.3 TIMP Name</b>	<b>Millet threshing and winnowing</b>
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	Inappropriate threshing and winnowing contributes to poor quality of millet seed which could fetch poor returns.
<p>What is it? (TIMP description)</p>  <p>Winnowing of millet</p>	<p>Millet can be threshed manually by beating the plants on a cement floor, or beating bagged grain with sticks once they are dry enough. Various types of threshing machines are available in different sizes, powered by petrol, diesel, or electricity, for small, medium, and large scale threshing of millet. Irrespective of the method used, millet seed can be easily damaged if threshed too roughly or when too dry. Thresh the drymillet grain on a clean surface such as a tarpaulin and then dry the threshed grains on a clean surface for two sunny days.</p> <p>Dry millet grains are winnowed to remove chaff, dust, foreign matter such as stones, broken grains, shrivelled, mouldy, insect</p>

	damaged, rotten discoloured or faded, and any remaining plant parts grains. Winnowing is then done using a winnowing tray ( 'uteo ' ) to separate the dry grain from the soil matter before sorting. Sorting should be properly done as this attracts a better price than unsorted millet grains
Justification	Threshing and winnowing enhances the quality of millet grains and reduce losses due to contamination
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	On farm and on station demonstrations Agricultural exhibitions Field days Agricultural shows Extension officers Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop. Application of timely harvesting and harvesting methods.
Partners/stakeholders for scaling up and their roles	Agricultural Extension: Farmer sensitization, On farm and on station demonstrations Farmer leaders: Group organization NGOs dealing with millet value chain to disseminate the practices
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Kitui, Coastal regions
Counties where TIMP will be up scaled	All finger millet growing counties – Busia, Kakamega, Bungoma, Siaya, Kisii, Nyamira, Migori, Kericho, Bomet, West Pokot.
Challenges in dissemination	Limited knowledge on threshing and winnowing of millet grains
Suggestions for addressing the challenges	Capacity building on millet postharvest handling practices
Lessons learned in up scaling if any	Create awareness on benefit of appropriate postharvest handling
Social, environmental, policy and market conditions necessary for development and up scaling	Opportunities for increased returns due to appropriate postharvest practices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet done
Estimated returns	Not yet done
Gender issues and concerns in development ,dissemination, adoption and scaling up	The adoption of management practices that reduce post-harvest losses lead to increased output, hence food security and income for the families, and especially women, the main producers Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Reduced losses hence increased income for women, VMGs and other producers

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 finger millet
VMG related opportunities	The innovation can improve food and nutrition security and increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Capacity building in Kitui, Machakos and Mbeere South
Application guidelines for users	Millet training manual Postharvest handling leaflets
<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	KALRO Scientists: Chrispus Oduori, Nungo, R, Opole R ,Maina FW, Kimani P, Ketiem P, Omondi S.P., Ombakho, Gathambiri C.
Lead organizations and scientists	Centre Director, KALRO-Kisii P.O. Box 523-40200, KISII; e-mail address: chrispus.oduori@kalro.org; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ ICRISAT Nairobi, P.O. Box 39063, NAIROBI, Kenya. Tel +254 20 7224550; e-mail: icrisat.nairobi@cgiar.org
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – where finger millet is grown

<b>2.7.4 TIMP Name</b>	<b>Finger Millet grain drying</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	Inappropriate millet drying contributes to poor quality and losses especially due to fungal contamination.
What is it? (TIMP description)	Threshed grain should be dried on mats, plastic sheets or wire mesh trays raised on a platform, mechanised solar dryers and electricity powered dryers. The grain should be spread thinly on the drying surface to allow air to pass through it and turned regularly to avoid overheating.
 <p>Drying of millet</p>	




Test the grain to see if it is dry enough for storage or market by biting or pinching grain with your finger nails. When dry enough, grain should break or crack rather than bend or stick between teeth or fingernails. One should test the moisture of the seed before threshing by using biting or pressing the seed between fore finger and thumb.

Justification	Appropriate drying enhances the quality of millet grains and reduce losses due to contamination
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	On farm and on station demonstrations Agricultural exhibitions Field days Agricultural shows Extension officers Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop. Application of drying methods.
Partners/stakeholders for scaling up and their roles	Agricultural Extension: Farmer sensitization, On farm and on station demonstrations Farmer leaders: Group organization NGOs dealing with millet value chain to disseminate the practices
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Kitui, Coastal regions
Counties where TIMP will be up scaled	All finger millet growing counties – Busia, Kakamega, Bungoma, Siaya, Kisii, Nyamira, Migori, Kericho, Bomet, West Pokot.
Challenges in dissemination	Limited knowledge on drying of millet grains
Suggestions for addressing the challenges	Capacity building on millet drying practices

Lessons learned in up scaling if any	Create awareness on benefit of appropriate drying techniques
Social, environmental, policy and market conditions necessary for development and up scaling	Opportunities for increased returns due to appropriate drying techniques
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet done
Estimated returns	Not yet done
Gender issues and concerns in development ,dissemination, adoption and scaling up	The adoption of management practices that reduce post-harvest losses lead to increased output, hence food security and income for the families, and especially women, the main producers Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Reduced losses hence increased income for women, VMGs and other producers
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 finger millet
VMG related opportunities	The innovation can improve food and nutrition security and increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Capacity building in Kitui, Machakos and Mbeere South
Application guidelines for users	Millet extension training manual Postharvest handling leaflets
<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	KALRO Scientists: Chrispus Oduori, Nungo, R, Opole R ,Maina FW, Kimani P, Ketiemi P, Omondi S.P., Ombakho, Gathambiri C.,
Lead organizations and scientists	Centre Director, KALRO-Kisii P.O. Box 523-40200, KISII; e-mail address: chrispus.oduori@kalro.org; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ ICRISAT Nairobi, P.O. Box 39063, NAIROBI, Kenya. Tel +254 20 7224550; e-mail: icrisat.nairobi@cgiar.org
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – where finger millet is grown

<b>2.7.5 TIMP Name</b>	<b>Finger Millet grain storage</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	Inappropriate millet storage are often completely consumed by storage pests within 10 to 12 months of storage. Most farmers sell millet shortly after harvest, partly because they have difficulty dealing with storage problems.
What is it? (TIMP description)	<p>Millet grain should be sun-dried to the recommended moisture content of 12-13 %. Use hermetic bags such as PICS (Purdue Improved Millet Storage) bags to store grain under air-tight conditions and keep away insects from the grain. Place grain in the innermost bag and tie this bag tightly. Then tie the middle bag, and finally tie the outermost bag. When all the bags are tied, any insects in the grain die from lack of oxygen. It is not necessary to treat seed against storage pests when using hermetic bags. Ensure the hermetic bags are protected from rats and mice for them to remain effective.</p> 
Justification	Appropriate storage enhances the quality of millet grains and reduce losses due to contamination
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, seed producers traders, and consumers
Approaches used in dissemination	<p>On farm and on station demonstrations  Agricultural exhibitions  Field days  Agricultural shows  Extension officers  Mass media – Agricultural programs  Promotional materials (posters/brochures/leaflets, manuals)</p>
Critical/essential factors for successful promotion	<p>Application of good agricultural practices to have a good crop.  Application of appropriate storage methods.</p>
Partners/stakeholders for scaling up and their roles	<p>Agricultural Extension: Farmer sensitization, On farm and on station demonstrations  Farmer leaders: Group organization  NGOs dealing with millet value chain to disseminate the practices</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Kitui, Coastal regions
Counties where TIMP will be up scaled	All finger millet growing counties – Busia, Kakamega, Bungoma, Siaya, Kisii, Nyamira, Migori, Kericho, Bomet, West Pokot.

Challenges in dissemination	Limited knowledge on drying of millet grains
Suggestions for addressing the challenges	Capacity building on millet postharvest handling practices
Lessons learned in up scaling if any	Create awareness on benefit of appropriate storage methods
Social, environmental, policy and market conditions necessary for development and up scaling	Opportunities for increased returns due to appropriate storage methods
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet done
Estimated returns	Not yet done
Gender issues and concerns in development ,dissemination, adoption and scaling up	The adoption of management practices that reduce post-harvest losses lead to increased output, hence food security and income for the families, and especially women, the main producers Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Reduced losses hence increased income for women, VMGs and other producers
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 finger millet
VMG related opportunities	The innovation can improve food and nutrition security and increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Capacity building in Kitui, Machakos and Mbeere South
Application guidelines for users	Millet Extension training manual Millet postharvest handling leaflets
<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	KALRO Scientists: Chrispus Oduori, Nungo, R, Opole R ,Maina FW, Kimani P, Ketiem P, Omondi S.P., Ombakho, Gathambiri C.,
Lead organizations and scientists	Centre Director, KALRO-Kisii P.O. Box 523-40200, KISII; e-mail address: chrispus.oduori@kalro.org; Tel. +254 (0) 723 770 895/ +254 (0) 736 220 821/ ICRISAT Nairobi, P.O. Box 39063, NAIROBI, Kenya. Tel +254 20 7224550; e-mail: icrisat.nairobi@cgiar.org
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties – where finger millet is grown

## Gaps

1. Estimate cost benefit of application of appropriate postharvest management techniques

## 2.8. Value Addition

2.8.1 TIMP Name	Finger Millet Crackie Snack Food Product.
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products depressing the crop value chain
What is it? (TIMP description) 	A dry snack food product made from finger millet, sweet potato, spices and wheat flour.
Justification	-Enhanced production of finger millet is likely to result in a glut, with consequent decline in prices. Diversification of finger millet utilization as food products will enhance uptake and consumption of finger millet, increasing the demand and thus creating market for the grain
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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.</li> </ul>

	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 e.g. micro-credit
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Finger millet farming communities, processors, and manufacturers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Counties where TIMPs will be upscaled	Kericho Bomet and West Pokot counties
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote commercialization. Develop appropriate packaging materials. Inter country machine sourcing to be encouraged.
Lessons learned	A good value added product penetrates the market very fast.
Social, environmental, policy and market conditions necessary	Target women and youth in society who are the major adopters (manufacturers) and consumers, respectively. The flour blending policy adopted recently will positively impact production of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated, needs to be determined
Estimated returns	Not yet estimated, needs to be determined
Gender issues and concerns in development, dissemination adoption and scaling up	Women are the key adopters and children the key consumers. Women and youth are the key adopters and the product is consumed by all ages.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development, dissemination adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects. Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence improved health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	

Success stories	Cottage production of the products in western Kenya like by EASTCOM Foods, Wamama Tuamue women group, Busibwabi widows and orphans group and PAWA bakers in Siaya and Busia respectively.
Application guidelines for users	Finger millet crackie production leaflet
F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: <a href="mailto:rhodazik@gmail.com">rhodazik@gmail.com</a>
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I, MoH in Counties, EASTCOM Foods; PAWA Bakers. Wamama Tuamue women group, Busibwabo widows and orphans group

### Gaps in Finger Millet Crackie Snack Food Product

- Identification of private sector investors in different counties
- Appropriate packaging and promotion

<b>2.8.2. TIMP Name</b>	<b>Finger Millet TAMUU Paste Food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet uptake in the market resulting in depressed prices utilization food products
What is it? (TIMP description)	A paste food product made from finger millet that can be used as bread spread or consumed directly.
Justification	- Enhanced production of finger millet is likely to result in a glut, with consequent decline in prices. Diversification of finger millet utilization as food products will enhance uptake and consumption of finger millet, increasing the demand and thus creating market for the grain
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers




Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Finger millet farming communities, processors, and manufacturers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Counties where TIMPs will be up scaled	Bomet, Kericho and West Pokot
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote commercialization.
Lessons learned	A good value added product addressing malnutrition with high potential to compete imported products. Certification of the product by Kenya Bureau of Standards recently will positively impact production of product.
Social, environmental, policy and market conditions necessary	Target malnourished individuals, small scale and medium scale entrepreneurs for production and malnourished individuals in the society who are the major adopters and humanitarian agencies, respectively.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Youth SMEs producers and malnourished individuals are the key consumers.
Gender issues and concerns in adoption and scaling up	Women are the key adopters and children the key consumers.

Gender related opportunities	Women stand to benefit in production of raw materials and youth SMEs in paste product and trade.
VMG issues and concerns in development and dissemination	Due to requirement for the use of several machines, development is limited to focused SMEs. Affirmative action is required to promote the crops production and product dissemination for the VMGs.
VMG issues and concerns in adoption and scaling up	Affordable nutritious food products locally made will lead to enhanced raw materials production and product consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	Opportunity to produce raw materials, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the product in western Kenya by EASTCOM Foods in Siaya.
Application guidelines for users	Finger millet TAMUU production leaflet
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	UoN, JKUAT, EASTCOM Foods.

### Gaps in Finger Millet Tamuu Paste Food Product

- Identification of private sector investors in different counties
- Appropriate packaging and promotion
- Validation with other potential legume ingredients
- Validation of requisite machines for making the product.

<b>2.8.3 TIMP Name</b>	<b>Finger Millet Onion bites Food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	A snack food product made from finger millet, sweet potato, wheat flour and onions.
	


Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production and utilization of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be up scaled	
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, and small scale entrepreneurs in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote commercialization and development of appropriate packaging materials
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women, youth and children in society who are the major adopters and consumers, respectively. The flour blending policy adopted recently will positively impact production and utilization of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development and dissemination	Women and youth are the key adopters in product development and dissemination while the general public including children the key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the products in western Kenya like by PAWA bakers, Busibwabo widows and orphans group and Wamama Tuamue women group in Busia County
Application guidelines for users	Finger millet Onion bites production leaflet
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I, MoH in Counties, EASTCOM Foods; PAWA Bakers.

### Gaps in Finger Millet Onion Bite Food Product

- Identification of small scale entrepreneurs in different counties
- Appropriate packaging and promotion
- Extensive dissemination

<b>2.8.4. TIMP Name</b>	<b>Finger Millet Cake Food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	A cake made from a finger millet – wheat flour composite.


	
Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be upscaled	
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process for home level and commercial.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, processors, and small scale entrepreneurs in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from

	regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote commercialization and production of appropriate packaging materials..
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women and youth in society who are the major adopters (producers) and consumers, respectively. The flour blending policy adopted recently will positively impact production of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Women and youth are the key adopters in development and dissemination and the general public key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters in production.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the products in western Kenya like by PAWA bakers in Siaya and Busia respectively.
Application guidelines for users	Finger millet cake production leaflet
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori

Partner organizations	ICRISAT Nairobi; MoALF&I in Counties, EASTCOM Foods; PAWA Bakers and Wamama Tuamue women group.
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### Gaps in Finger Millet Cake Snack Food Product

- Identification of small scale entrepreneurs in different counties
- Appropriate packaging and promotion
- Validation of requisite community baking ovens.


<b>2.8.5. TIMP Name</b>	<b>Finger Millet Chapatti Food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	A main meal dish made from a finger millet – wheat flour composite.
	
Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be upscaled	
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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> </ul>

	<ul style="list-style-type: none"> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, processors, and small scale entrepreneurs in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops due to color.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of households and food outlets to promote commercialization.
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women, youth and food outlets in society are the major adopters (producers) and general community as consumers, respectively. The flour blending policy adopted recently will positively impact production and utilization of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Women and youth are the key adopters and general community the key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters and children the key consumers.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Affordable nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Production of the products in western Kenya by PAWA bakers, Wamama Tuamue in Busia county.
Application guidelines for users	Finger millet Chapatti production leaflet
<b>F: Status of TAMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling and requires further research as regards to variety effect on product.
<b>F: Contacts</b>	

Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: <a href="mailto:rhodazik@gmail.com">rhodazik@gmail.com</a>
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties, EASTCOM Foods; PAWA Bakers and Wamama Tuamue women group.

### Gaps in Finger Millet Chapatti Food Product

Appropriate packaging and promotion


<b>2.8.6. TIMP Name</b>	<b>Finger Millet Mandazi Food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	A snack food product made from a finger millet – wheat flour blend.
	
Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production and utilization of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be upscaled	
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <li>• Farmer Groups for activity implementation and promotion</li> </ul>

	<ul style="list-style-type: none"> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, and SMEs in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops due to color;
Recommendations for addressing the challenges	Promotional campaigns; sensitization of policy makers; to promote consumption and commercialization.
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women and youth in society who are the major adopters (SMEs) and general public consumers, respectively. The flour blending policy adopted recently will positively impact production and utilization of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Women and youth are the key adopters and general public the key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters and general public the key consumers.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Affordable nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the products in western Kenya like by PAWA bakers, Wamama Tuamue women group and Busibwabo widows and orphans group in Busia county.
Application guidelines for users	Finger millet Mandazi production leaflet

<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties, EASTCOM Foods; PAWA Bakers.

### Gaps in Finger Millet Mandazi Food Product

Appropriate packaging and promotion


<b>2.8.7. TIMP Name</b>	<b>Finger Millet Blended and Composite Flour Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	Flour products made from finger millet – wheat or maize flour composite.
	
Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production and utilization of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be up scaled	
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).

Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <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 e.g. micro-credit</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, processors, and manufacturers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote utilization and commercialization.
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women and youth in society who are the major adopters (manufacturers) and consumers, respectively. The flour blending policy adopted recently will positively impact production and utilization of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Women and youth are the key adopters and the general public key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters, children, pregnant and lactating mothers and older men and women the key consumers.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Affordable nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the products in western Kenya like by EASTCOM Foods and PAWA bakers in Siaya and Busia respectively.
Application guidelines for users	Finger millet Blended and Composite Flour production leaflet

<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Requires validation;
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties, EASTCOM Foods; PAWA Bakers.

### Gaps in Finger Millet Blended and Composite Flours

Appropriate packaging and promotion  
Validation in nutrient composition

<b>2.8.8. TIMP Name</b>	<b>Finger Millet Biscuit, snack food Product.</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Limited finger millet utilization food products
What is it? (TIMP description)	Snack food product made from finger millet – wheat flour composite.
	
Justification	-Diversification of finger millet food products will enhance consumption of finger millet, enhance demand and thus spur increased production and utilization of finger millet.
Region promoted	Western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya
Counties where TIMP will be upscaled	Bomet, Kericho, and West Pokot
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension agencies, traders, and consumers
Approaches used in dissemination	On-farm experimentation, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, leaflets etc.
Most effective approach	On-farm experimentation, training, and practical demonstration of preparation process.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building and networks; promotions involving Public Private partnerships (PPP).
Partners/stakeholders for scaling up	Public and private partners –[MOALF&I) for extension, ICRISAT for technical backstopping and promotion; FIPs (Farmer Input Promotion) for promotion

	Farmer Groups for activity implementation and promotion Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and others e.g. NGOs, CBOs, and FBOs to provide specialist services e.g. micro-credit
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Finger millet farming communities, processors, and manufacturers in western Kenya Counties of Kakamega, Busia, Bungoma, and Siaya.
Challenges in dissemination	Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from regulatory agencies e.g. KEBS; lack of credit facilities. Undeveloped packaging materials.
Recommendations for addressing the challenges	Promotional campaigns; sensitization of regulatory agencies and policy makers; linkage to credit facility providers to promote utilization and commercialization.
Lessons learned	A good value added product will penetrate the market very fast.
Social, environmental, policy and market conditions necessary	Target women and youth in society who are the major adopters (manufacturers) and consumers, respectively. The flour blending policy adopted recently will positively impact production and utilization of product.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	Women and youth are the key adopters and the general public key consumers.
Gender issues and concerns in adoption and scaling up	Women and youth are the key adopters, children, youth, men and women the key consumers.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination	Due to prejudice associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus, affirmative action is required to promote the crop for the VMGs including value addition aspects.
VMG issues and concerns in adoption and scaling up	Affordable nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence enhancing their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced nutritious food products
<b>E: Case studies/profiles of success stories</b>	
Success stories	Cottage production of the products in western Kenya like by EASTCOM Foods and PAWA bakers in Siaya and Busia respectively.
Application guidelines for users	Finger millet Biscuit snack production leaflet

F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Requires validation;
<b>F: Contacts</b>	
Contacts	KALRO-Alupe, P.O. Box 278 – 50400, BUSIA (K). Tel +254 724 687 774; e-mail address: rhodazik@gmail.com
Lead organization and scientists	KALRO, Dr. Rhoda A. Nungo and Dr. Chrispus Oduori
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties, EASTCOM Foods; PAWA Bakers.


### Gaps in Finger Millet Biscuit Snack Food Product

Appropriate packaging and promotion

Validation in nutrient composition

Validation of Community fabricated ovens and cutters.

## 2.9. Mechanization of Finger Millet Production Activities

2.9.1. TIMP Name	Power Tiller
Category (i.e. technology, innovation or management practice)	Technology 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Difficult to prepare a uniform fine tilth seedbed manually Slow and tedious processes of seedbed preparation in a commercialized finger millet commodity Drudgery leads to low acreage Delayed operation lead to late planting High cost of manual Labour
What is it? (TIMP description)	A Power tiller is a low powered two-wheeled agricultural implement also referred to as a walking tractor 8-16hp that can be fitted with implements such as a rotary tiller, disk harrow, mouldboard plough, trailer, chisel or water pump at alternate times for easing farm operations. It can complete one hectare in two hours per operator. This will vary depending on the climatic conditions, soil types, soil moisture content, operator stamina and experience. Fuel consumption is about 15 litres per ha. Though


	these results may vary with the technical ability or aptitude of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation, sowing seed, planting seed, spraying of fertilizer or herbicide and even irrigation. In addition, can also be used for threshing and transporting produce. A power tiller is ideal where the land size is small. Farm sizes less than one hectare may limit maneuverability of conventional tractors and manual Labour is costly to maintain apart from being slow.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of the TIMP	Finger Millet farmers and researchers
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release improved finger millet varieties A platform for interaction of finger millet value chain stakeholders Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where the TIMP is already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Lack of machines Lack of facilitation to demonstration site High initial cost for small-scale machines
Suggestions for addressing the challenges	Establish finger millet innovation platforms Acquisition of the machines Lack of facilitation to demonstration site Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms Mechanization in agriculture increases production Mechanization releases labour to alternative requirement areas Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in agricultural production Include all gender groups in research, and validation. Appropriate policy formulation of agricultural mechanization

<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	Gender Unfriendly and expensive machines Finger Millet machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<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	Demonstrations and training User 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, 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, Pole F.N.
Partner organizations	Local Fabricators

<b>2.9.2. TIMP Name</b>		<b>4 Wheeled Tractor 50Hp</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	Difficult to prepare a uniform fine tilth seedbed manually Delayed operation lead to late planting Slow and tedious processes of seedbed preparation, in a commercialized finger millet commodity High cost of manual labour
What is it? (TIMP description)	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.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for 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.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Finger Millet farmers and researchers
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Applied and adaptive Research to evaluate and recommend the tractor for small scale farmers. A platform for interaction of finger millet value chain stakeholders Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery dealers NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Lack of tractors Lack of facilitation to demonstration site High initial cost for small-scale machines
Suggestions for addressing the challenges	Establish a 4-wheeled innovation platform Acquisition of the machines Lack of facilitation to demonstration site Build financial capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	Chances of successful up-scaling are higher when diverse value chain stakeholders collaborate in an innovation platform

	Partnership is important in technology dissemination and adoption Mechanization in agriculture increases production Mechanization releases labour to alternative requirement areas Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in agricultural production Include all gender groups in research, and validation. Appropriate policy formulation of agricultural mechanization
<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	Gender Unfriendly and expensive machines Finger Millet machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<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	Demonstrations and training User manuals
<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>2.9.3. 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	<p>Slow and tedious processes of seedbed preparation, in a commercialized finger millet commodity</p> <p>Difficult to prepare a uniform fine tilth seedbed manually</p> <p>Delayed operation lead to late planting</p> <p>High cost of manual Labour</p>	
What is it? (TIMP description)	<p>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.</p>	
Justification	<p>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.</p>	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
Users of TIMP	Potato farmers and researchers	
Approaches used in dissemination	<p>Farmer field and business Schools(FFBS)</p> <p>Agricultural Innovation Platforms (AIP)</p> <p>Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</p>	
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release improved cabbage varieties</p> <p>A platform for interaction of finger millet value chain stakeholders</p> <p>Multiple usage, timeliness, efficiency and low cost</p>	
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)</p> <p>Machinery fabricators</p> <p>NGO supporting farmers for dissemination</p>	

<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<b>Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</b> Lack of machines Lack of facilitation to demonstration site High initial cost for small-scale machines
Suggestions for addressing the challenges	<b>Establish finger millet innovation platforms</b> Acquisition of the machines Lack of facilitation to demonstration site Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<b>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</b> Partnership is important in technology dissemination and adoption <b>and this can be facilitated through innovation platforms</b> Mechanization in agriculture increases production Mechanization releases labour to alternative requirement areas Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in agricultural production Include all gender groups in research, and validation. Appropriate policy formulation of agricultural mechanization
<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	Gender Unfriendly and expensive machines Potato machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<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	Demonstrations and training User 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, 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.

2.9.4. TIMP Name		Disk Harrow
Category (i.e. technology, innovation or management practice)	Technology	
<b>A: Description of the technology, innovation or management practice</b>		
Problem to be addressed	Slow and tedious processes of seedbed preparation, in a commercialized finger millet commodity Difficult to break clods manually Delayed operation lead to late planting Low acreage because of lack of manual labour High cost of manual labour	
What is it? (TIMP description)	A harrow, farm implement used to pulverize soil, break up crop residues, uproot weeds and cover seed. It is a farm implement used for surface tillage. It is used after ploughing for breaking up and smoothing out the surface of the soil. The purpose of harrowing is to break up clods and to provide a soil structure, called tilth, that is suitable for planting seeds. Coarser harrowing may also be used to remove weeds and to cover seed after sowing.	
Justification	Creating of a crumbly layer for planting manually is tedious.	

	<p>It is not possible to manually protect the soil surface from rapid drying. Improving both the air and water penetrability into soil can be too expensive if manually undertaken.</p> <p>Manual operation will reduce microbiological processes in the soil</p> <p>Manual land harrowing Improves nutrient availability to plants.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Finger millet farmers and researchers
Approaches used in dissemination	<p><b>Farmer field and business Schools (FFBS)</b></p> <p><b>Agricultural Innovation Platforms (AIP)</b></p> <p>Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</p>
Critical/essential factors for successful promotion	<p><b>Applied and adaptive Research to test, validate and release improved cabbage varieties</b></p> <p><b>A platform for interaction of finger millet value chain stakeholders</b></p> <p>Multiple usage, timeliness, efficiency and low cost</p>
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)</p> <p>Machinery fabricators</p> <p>NGO supporting farmers for dissemination</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<p><b>Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders</b></p> <p>Lack of machines</p> <p>Lack of facilitation to demonstration site</p> <p>High initial cost for small-scale machines</p>
Suggestions for addressing the challenges	<p><b>Establish Finger millet innovation platforms</b></p> <p>Acquisition of the machines</p> <p>Lack of facilitation to demonstration site</p> <p>Build capacity through efficient agricultural production to afford the cost</p>
Lessons learned in up scaling if any	<p><b>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</b></p> <p>Partnership is important in technology dissemination and adoption <b>and this can be facilitated through innovation platforms</b></p> <p>Mechanization in agriculture increases production</p> <p>Mechanization releases labour to alternative requirement areas</p> <p>Provides low cost farm operations</p>
Social, environmental, policy and market conditions necessary for development and up scaling	<p>Creation of awareness on mechanization importance in agricultural production</p> <p>Include all gender groups in research, and validation.</p> <p>Appropriate policy formulation of agricultural mechanization</p>
<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	Gender Unfriendly and expensive machines Finger millet machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<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	Demonstrations and training User 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, 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,
Partner organizations	Local Fabricators
Partner organizations	Local Fabricators

<b>2.9.5. TIMP Name</b>	<b>Small grain planter</b>
<b>Category (technology, innovation or management practice)</b>	Technology

		
<b>A: Description of the technology, innovation or management practice</b>		
<p>Problem to be addressed</p>	<p>Slow and tedious processes of planting, in a commercialized Finger Millet commodity          Difficult to deliver small grains in a row at specified seed rate manually          Delayed operation lead to late planting          Low acreage because of lack of manual Labour          High cost of manual Labour</p>	
<p>What is it? (TIMP description)</p>	<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 harrowed land to plant.</p>	
<p>Justification</p>	<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 uniformly.</li> <li>• Manual operation will reduce microbiological processes in the soil</li> <li>• Mechanical finger millet seed planting increases germination uniformity</li> </ul>	
<b>B: Assessment of dissemination and scaling up/out approaches</b>		
<p>Users of TIMP</p>	<p>Finger Millet farmers and researchers</p>	
<p>Approaches used in dissemination</p>	<p>Farmer field and business Schools(FFBS)          Agricultural Innovation Platforms (AIP)          Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</p>	

Critical/essential factors for successful promotion	Applied and adaptive research to evaluate and recommend A platform for interaction of finger millet value chain stakeholders Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of finger millet 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 finger millet 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>• <b>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</b></li> <li>• Partnership is important in technology dissemination and adoption <b>and this can be facilitated through innovation platforms</b></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	Gender Unfriendly and expensive machines Finger Millet machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in	Facilitation to access information Affordability and easy to maintain machines


development, dissemination, adoption and scaling up	
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	User manuals and leaflets
<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>2.9.6. TIMP Name</b>	<b>Motorised Sprayer</b>																																																																								
Category (technology, innovation or management practice)	Technology <div style="display: flex; justify-content: space-around; align-items: center;">  <table border="1"> <caption>Nozzle Guide for Band and Directed Spraying</caption> <thead> <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> </div>		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>Growth Regulators</b>	Good			Very Good																																																																					
<b>A: Description of the technology, innovation or management practice</b>																																																																									
Problem to be addressed	<ul style="list-style-type: none"> <li>It is a slow and tedious processes of manual spraying Finger Millet; Finger Millet has a high number of pests that invade leaf, stem tuber,</li> </ul>																																																																								
What is it? (TIMP description)	<ul style="list-style-type: none"> <li>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</li> </ul>																																																																								

	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.
Justification	<ul style="list-style-type: none"> <li>• Pest reduce yields up to 98% and are a major menace in agricultural production. Before finger millet forms a canopy, broad leaved weeds compete with finger millet 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.</li> <li>• A modern motorized knapsack power that pumps four times faster and covers a wide area in a short time than the manual sprayer</li> <li>• With the motorized sprayer, farmers can spray up to 2ha of land in one day as compared to the manual one which covers only one in a day.</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Finger Millet Farmers and agribusiness entrepreneurs</li> </ul>
Approaches 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 cabbage varieties</li> <li>• A platform for interaction of finger millet value chain stakeholders</li> <li>• Use by Farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Machinery fabricators</li> <li>• NGO supporting farmers(AGGRA)</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of finger millet 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 finger millet innovation platforms</li> <li>• Encourage group/cooperative ownership</li> </ul>

	<ul style="list-style-type: none"> <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	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Creates employment at production, transportation, processing and distribution</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Creates employment especially for youth</li> <li>• Reduces drudgery for women farmers as well as men</li> </ul>
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	
<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	User manuals and leaflets
<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>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	<ul style="list-style-type: none"> <li>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.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Creates employment at production, transportation, processing and distribution</li> </ul>
Gender related opportunities	
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<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

2.9.7. TIMP Name	Finger Millet Machine harvesting
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>• 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)	<ul style="list-style-type: none"> <li>• The modern combine harvester, is a versatile machine designed to efficiently harvest a variety of grain crops. The name derived from its combining four separate harvesting operations; reaping, threshing, gathering, and winnowing to a single process. Among the crops harvested with a combine are wheat, rice, oats, rye, barley, corn (maize), sorghum, soybeans, flax (linseed), sunflowers, rapeseed and finger millet. The separated straw, left lying on the field, comprises the stems and any remaining leaves of the crop with limited nutrients left in it: the straw is then either chopped, spread on the field and ploughed back in or baled for bedding and limited-feed for livestock.</li> <li>• Combine harvesters are one of the most economically important labour-saving inventions, significantly reducing the fraction of the population engaged in agriculture.</li> </ul>
Justification	<ul style="list-style-type: none"> <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> <li>• The key advantage of mechanized harvesting with a combine harvester is that it not only reduces the production costs but also improves labour efficiency.</li> <li>• It is very useful where labour scarcity is an issue.</li> </ul>

	<ul style="list-style-type: none"> <li>Combine harvester provides cleaner grains by effectively separating weeds from grain.</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Finger Millet Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP) Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release improved cabbage varieties A platform for interaction of Finger Millet value chain stakeholders
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	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>Lack of finger millet 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 finger millet 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>	Ready for upscaling
Basic costs	

Estimated returns	Not yet
Gender issues and concerns in development, dissemination, adoption and scaling up	Gender Unfriendly and expensive machines Finger millet machines should be designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	
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 and rice
Application guidelines for users	User manuals Leaflets
<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	Training on local use and transportation will make it more usable. Power tree pruner is affordable and could help VMGs exploit
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,
Partner organizations and contacts	Tecsols Ltd – Nakuru

## 2.10. Finger Millet Farming Business and Marketing Practices

2.10.1. TIMP Name	Transformative Model of Finger millet production
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The Finger millet production is dominated by subsistence level with meager output getting to markets
What is it? (TIMP description)	An approach to organize Finger millet production based on market orientation. This is a transformation model of smallholder farmers' from subsistence to semi-commercial to fully commercial. At the subsistence level, farmers use traditional inputs and the outputs consumed at home. At the semi-commercial level, farmers use both traditional and improved inputs while the output is consumed at home and some get into the markets. At fully commercial, inputs are accessed from the markets and outputs solely for the markets.
Justification	Without transformation of finger millet production, the crop will remain subsistence and commercialization will not be attainable, 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 Television Social media (WhatsApp, Facebook, twitter) Internet Farmers' groups Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Acceptance of smallholder farmers to produce Finger milletes Availability of investors Prices of Finger millet Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – investments in Finger millet production County extension staff - Organization of farmers and technical service delivery NGOs – Organization of farmers and service delivery Private sector (local traders and exporters) – Support in input services and providing markets for the Finger millet production Research institutions – Availing improved seeds, backstopping

<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Disorganization and scattered farmers Small-scale farming Group dynamics Limited investment by buyers Prices of Finger millet Level of policy support
Suggestions for addressing the challenges	Disorganization and scattered farmers – Formation of marketing groups Small-scale farming – Aggregation of production Group dynamics – Capacity building Limited investment by buyers – County government support Prices of Finger millet – Setting minimum price Level of policy support – price policy, subsidies, inputs support
Lessons learned in up scaling if any	Production of Finger millet without agreed buyers Individual marketing instead of collective marketing
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – acceptability by the farmers, group dynamics, cultures Environmental conditions – Enhancing natural resource management Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, investment environment
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Different acceptance characteristics by youth, females and males. Gender roles in the production of Finger millet. Availability of technologies for pre-harvesting, harvesting and post-harvesting Adoption and scaling – Different acceptance characteristics, Gender inclusion in the formation of producer organizations. Access to production resources by youth, females and males
Gender related opportunities	Income generation opportunities by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – reduction in costs of production Adoption and scaling up - Limited access to seed and information on new varieties and production techniques
VMG related opportunities	Income generation using farmer-market linking models Access to inputs and markets through linkages and producer organization
<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI– Katumani
Partner organizations	

## GAPS

### *Further research*

Efficiency evaluation of the farmer-market linking models

Equity distribution among the producers

Productivity levels among the smallholder farmers due to farmer-market linking models

Farmer accessibility to production inputs

<b>2.10.2. TIMP Name</b>	<b>Building a Business Plan for Finger millet 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	Unplanned and traditional production of finger millet, leading to lack of production targets, losses and market failure.
What is it? (TIMP description)	A Finger millet 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, Finger millet 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 Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Education levels of the farmers and investors in Finger millet production Levels of experiences in Finger millet production Availability of information on Finger millet production and marketing Applied and adaptive Research to test, validate and release improved Finger millet varieties

	A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – Users of business plans County extension staff - Capacity building NGOs – Capacity building Private sector (local traders, exporters) – Buyers of Finger millet Research institutions – Capacity building Financial Institutions – Financial support
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Disorganization and scattered farmers Small-scale farming Inadequate information to stakeholders on Finger millet production and marketing Levels of policy support Levels of education
Suggestions for addressing the challenges	Disorganization and scattered farmers – Formation of production clusters Small-scale farming – aggregation of production to assume large scale-farming Inadequate information to stakeholders on the Finger millet production – Developing information hub Level of policy support – support in extension services Levels of education – Capacity building
Lessons learned in up scaling if any	Low adoption of business planning
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Acceptable in Counties growing Finger millet Environmental conditions – Availability of water resources Policy conditions – Policy support in opportunities selected
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Ability to collect data by the youth, men and females Adoption and scaling – Education levels among youth, women and men
Gender related opportunities	Increased management skills among youth, women and men Increased profitability.
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Levels of resource use in the business plan Adoption and scaling up – Profitability indication in the business plan
VMG related opportunities	Production opportunities – Increased management skills Assessment of markets for Finger millet for VMGs

<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

## GAPS

### *Further research*

- Impact of business plan on Finger millet production
- Adoption of business plan

<b>2.10.3. TIMP Name</b>	<b>Collective 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	Market inaccessibility due to individual farmer marketing of finger millet, leading to low market power.
What is it? (TIMP description)	Collective marketing is marketing as a group where farmers establish an entity to create market links. It involves formation of a group of farmers with an objective of reducing market inaccessibility.
Justification	Due to small-scale farming of finger millet, 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 Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Production programme outlined Sell their produce before the collective sale

	<p>The farmer is not able to deliver the agreed amount to the group</p> <p>Side-selling</p> <p>Bad weather</p> <p>Variable quality</p> <p>Applied and adaptive Research to test, validate and release improved Finger millet varieties</p> <p>A platform for interaction in Finger millet value chain stakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Farmers – Defining production programme</p> <p>County extension staff - Capacity building</p> <p>NGOs – Capacity building</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	<p>Disorganization and scattered farmers</p> <p>Small-scale farming</p> <p>Inadequate information to stakeholders on Finger millet production and marketing</p> <p>Defining production programmes of Finger millet</p> <p>Levels of policy support</p>
Suggestions for addressing the challenges	<p>Disorganization and scattered farmers – Formation of production clusters</p> <p>Small-scale farming – aggregation of production to assume large scale-farming</p> <p>Inadequate information to stakeholders on Finger millet production – Developing information hub</p> <p>Defining production programmes of Finger millet – SWOT analysis</p> <p>Level of policy support – support in extension services</p>
Lessons learned in up scaling if any	<p>Commitment: low commitment</p> <p>Volume target: low volume due to side-sales</p>
Social, environmental, policy and market conditions necessary for development and up-scaling	<p>Social conditions – lack of trust among members</p> <p>Environmental conditions – favorable condition for Finger millet production</p> <p>Policy conditions – Infrastructural support</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	<p>Development and dissemination – Inclusivity of youth, women and men in marketing group</p> <p>Adoption and scaling – Benefits of marketing as a group to youth, women and men</p>
Gender related opportunities	<p>Bigger volumes</p> <p>Uniform quality</p> <p>Reliable sellers</p> <p>Reliable buyers</p> <p>Continuous supply</p>

	Higher price Organization
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Finger millet production programmes for VMGs Adoption and scaling up – Levels of profitability
VMG related opportunities	Production opportunities – Finger millet production programmes Profitable opportunities
<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	Dr. Wambua, J,M
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

## GAPS

### *Further research*

- Profitable opportunities
- Performance of marketing as a group

<b>2.10.4. 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	The problem of failure of profitability analysis is common among the smallholder farmers. Lack of profitability analysis by farmers in finger millet production, leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise.
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the Finger millet agro-enterprise
Justification	Profitability analysis reviews the management success and sustainability of the Finger millet 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

	Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Record keeping of costs and returns Ability of farmers to keep records Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – record keeping County extension staff - Facilitators NGOs – Facilitators Private sector (local traders and exporters) – Buyers Research institutions – Facilitators
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Inability of farmers to keep records Use of non-costed family labour in Finger millet production
Suggestions for addressing the challenges	Inability of farmers to keep records – capacity building Use of non-costed family labour in Finger millet production – capacity building on how to cost family labour
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Awareness on record keeping Environmental conditions – suitable for the increased production of Finger millet Policy conditions – Policy support in costs of inputs and prices of outputs Market conditions – Higher prices than costs
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – low income to youth, women and men Adoption and scaling – high costs applicable to the youth, women and men
Gender related opportunities	Increased income Indicator of sustainable Finger millet business
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – low income to VMGs Adoption and scaling up – high costs to VMGs
VMG related opportunities	Increased production and sales of Finger milletes by youth, females and males in the production of Finger millet.
<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

### **Further research**

- Investigation on strategies to reduce costs of production of Finger millet
- Investigation on price increasing strategies

<b>2.10.5. TIMP Name</b>	<b>Market research for Finger millet 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	Failure of the smallholder farmers in gathering information on markets, leading to knowledge asymmetries among the smallholder farmers. Also this leads to poor connectivity of smallholders to distance 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 Processors
Approaches to be used in dissemination	Trainings Factsheets Manuals Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Can the farmers increase production within their group

	<p>How will the farmers increase their production and sales (more technology, more land, more members)</p> <p>Can the farmers work with other existing groups (available/not available)</p> <p>Do the farmers need to form new groups</p> <p>Applied and adaptive Research to test, validate and release improved Finger millet varieties</p> <p>A platform for interaction in Finger millet value chain stakeholders</p>
Partners/stakeholders for scaling up and their roles	<p>Farmers – Members of producer organization</p> <p>County extension staff - Capacity building</p> <p>NGOs – Capacity building</p> <p>Private sector (local traders and exporters) – Targeted markets</p> <p>Research institutions – Capacity building</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	<p>Issues related to increasing production from existing group</p> <p>Issues related to increasing production from increasing size of existing groups</p>
Suggestions for addressing the challenges	<p>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</p> <p>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</p>
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<p>Social conditions – are there other farmers who want to join the group</p> <p>Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group</p> <p>Policy conditions – Policies supporting formation and functioning of producer organizations</p> <p>Market conditions – new markets</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	<p>Development and dissemination – Participation by youth, women and men in the development of scaling up plan</p> <p>Adoption and scaling – Participation by youth, women and men in the development of scaling up plan</p>
Gender related opportunities	Increase in production and sales by youth, females and males in the production of Finger millet.

VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Participation by VMGs in the development of scaling up plan Adoption and scaling up – Participation by VMGs in the development of scaling up plan
VMG related opportunities	Increase in production and sales by VMGs of Finger millet
<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

## GAPS

### *Further research*

Processes in scaling up agro-enterprise development approach and production  
Effects of scaling up plan

<b>2.10.6. TIMP Name</b>	<b>Contracted Finger millet production 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	Market failure in finger millet 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 Extension Research institutions Farmer cooperative societies
Approaches to be used in dissemination	Barazas Trainings Factsheets Manuals Media Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Willing farmers Availability of traders Competitiveness of Finger millet Production volume Enforcement and bidding contract farming Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – Contract party and beneficiaries County extension staff - Capacity building, signing contract NGOs – Capacity building Private sector (local traders and exporters) – Contract party and beneficiaries Research institutions – Capacity building
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Disorganization and scattered farmers Small-scale farming Lack of information by part of the producers Level of policy support
Suggestions for addressing the challenges	Disorganization and scattered farmers – Formation of production clusters Small-scale farming – Increase volume through increase in productivity

	Lack of information by part of the producers – Capacity building Level of policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Conflicts with traditional farming Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management Policy conditions – Policy in formulation and enforcement Market conditions – volume, place, price, promotion, traders
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Involvement of youth, males and females in signing of the contract Adoption and scaling – Equity distribution of income based on contract farming
Gender related opportunities	Market access, increased income, improved livelihood
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Capacity building VMGs Adoption and scaling up – Participation in signing contract farming
VMG related opportunities	Market access, increased income, improved livelihood
<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
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The guidelines for the contract farming are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

### Gaps for further research

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

<b>2.10.7. 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 finger millete leading to low prices

What is it? (TIMP description)	Marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of finger millet, the market outlook will be narrow
<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 Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Organization of farmers Availability of innovations Achievement of profit Access to finance Availability of facilitators Availability of many traders Production volume and quality Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – Acceptability of innovations County extension staff - Facilitators NGOs – Facilitators Private sector (local traders and exporters) – Buyers Research institutions – Facilitators
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Small-scale farming Availability of information Profitability in Finger millet farming Levels of policy support
Suggestions for addressing the challenges	Small-scale farming – capacity building to farmers Availability of information on innovations Profitable innovations Strengthening county policy support
Lessons learned in up scaling if any	Reduced cost of production, increased profit

Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Conflicts with traditional methods Environmental conditions – Use of pesticides and disposal Market conditions – Contract farming, access to inputs such as fertilizer
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Involvement of youth, men and females in the innovations adoption Adoption and scaling – Differentiated innovations for instance spraying by females is difficult. Youth is normally engaged
Gender related opportunities	Increased production and sales of Finger millet by youth, females and males.
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Involvement of VMGs in the innovations adoption Adoption and scaling up – Capacity building
VMG related opportunities	Increased production and sales of Finger millet by VMGs leading to improved livelihood
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Available innovations are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Dr. Wambua, J.M.
Lead organization and scientists	KALRI_AMRI-Katumani
Partner organizations	

### Gaps for further research

Sustainability based on market prices

Innovations for the increased productivity

<b>2.10. 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 Processors
Approaches to be used in dissemination	Trainings Factsheets Manuals Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Education levels of the farmers and investors in Finger millet production and profitability analysis Levels of experiences in Finger millet production Availability of information on Finger millet production and marketing Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – Sellers of Finger millet production County extension staff - Capacity building NGOs – Capacity building Private sector (local traders and exporters) – Buyers of Finger millet Research institutions – Capacity building
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Low digital skills of farmers Unconsolidated produce for the market Small-scale farming Inadequate information to stakeholders on the Finger millet production and marketing and profitability Internet connectivity Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	Low digital skills of farmers – capacity building Unconsolidated produce for the market – Delivery of produce to the designated centres Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce

	Inadequate information to stakeholders on the Finger millet production and marketing and profitability - Developing information hubs Internet connectivity – Information hubs Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	Requires stakeholders involvement Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – low levels of adoption of information technology Environmental conditions – improved internet connectivity Policy conditions – Policy supporting information hubs Market conditions – high costs of information technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Capacity building in digital skills for the youth, men and females Adoption and scaling – Capacity building on benefits of digital marketing skills for the youth, men and females
Gender related opportunities	Improved accessibility of information due to availability of mobile phones by youth, males and females
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – Capacity building on digital skills Adoption and scaling up – Capacity building on benefits of digital marketing skills for the VMGs
VMG related opportunities	Improved accessibility of information due to availability of mobile phones by VMGs
<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)	The platforms are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

### Gaps for further research

Levels of digital skills by farmers

Performance of the internet marketing in terms of productivity, sales and profitability

### AGRICULTURAL POLICY OPTIONS

<b>2.11.1. 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	Smallholder farmers' agency has been largely neglected in the Agricultural policy making in Kenya. The smallholder farmers are framed as having no innovations or insights to offer. Indeed, they are considered to have little agency beyond the adoption of modernizing innovations that are believed to transform agriculture and build livelihoods.
What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provide objectives.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Policy makers Traders Processing industries Extension NGOs Research institutions
Approaches to be used in dissemination	Meetings Radio Television Social media (WhatsApp, Facebook, twitter) Internet Farmers' groups Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Availability of stakeholders Availability of specific Finger milletes-based policies Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – Demanding Finger milletes policies to support production and marketing County extension staff - Sensitization of farmers

	<p>NGOs – Sensitization of farmers</p> <p>Private sector (local traders and exporters) – Demanding Finger milletes policies to support production and marketing</p> <p>Research institutions – Sensitization of stakeholders</p> <p>Policy makers – Assist in policy making</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• <b>Value Chain:</b> Finger millet yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials.</li> <li>• <b>Standards:</b> Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted.</li> <li>• <b>Aggregation:</b> Aggregation models including cooperatives—suffered after the downturn in Finger milletes production, wherein many farmers abandoned Finger milletes production. These weak organizations provide few services to farmers while providing limited bargaining power.</li> <li>• <b>Financial Incentives:</b> The government provides only limited support to Finger milletes producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs). Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• <b>Value Chain:</b> Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors.</li> <li>• <b>Standards:</b> Existing Finger milletes standards and classifications should be redesigned to align with Kenya’s climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to</li> </ul>

	<p>promote and enable higher quality production through input access and CSA extension training.</p> <ul style="list-style-type: none"> <li>• <b>Aggregation:</b> Partnerships between farmer cooperatives and Finger milletes producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs.</li> <li>• <b>Financial Incentives:</b> Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based Finger milletes payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.</li> </ul>
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Traditional farming of Finger milletes where there is no value chain</li> <li>• Environmental conditions – Use of pesticides</li> <li>• Policy conditions – Lacking specific Finger millet policy</li> <li>• Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Development and dissemination – Supporting youth, females and males in production and marketing Finger milletes</li> <li>• Adoption and scaling – Supporting youth, females and males in production and marketing Finger milletes</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Providing incentives to youth, females and males in the production and marketing of Finger milletes.</li> <li>• Increased income by youth female and male</li> <li>• Increased employment by youth, females and males</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Development and dissemination – Supporting VMGs in production and marketing Finger milletes</li> <li>• Adoption and scaling up - Supporting VMGs in production and marketing Finger milletes</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Providing incentives to VMGs in the production and marketing of Finger milletes</li> <li>• Increased income by VMGs</li> <li>• Increased employment by VMGs</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
<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

### Gaps for further research

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers of Finger milletes
- Farmer accessibility to production inputs
- Impact on Finger millet prices

<b>2.11.2. 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 Finger millet production, marketing and processing are considered.
Justification	<b>Failure to consider Finger millet issues during planning would lead to omission in the development funding.</b>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Traders Processing industries Extension NGOs Research institutions Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (WhatsApp, Facebook, twitter), internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability of agricultural policies and specific Finger millet-based policies</li> <li>• Issues in Finger millet business</li> <li>• Specific policy objective statement</li> <li>• Applied and adaptive Research to test, validate and release improved Finger millet varieties</li> <li>• A platform for interaction in Finger millet value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Demanding Finger millet 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 Finger millet 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	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
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 Finger millet value chain</li> <li>• Finger millet production are specific to agro-ecological zones and not all the Counties in Kenya grow Finger millet</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 Finger millet value chain – strengthening Finger millet value chain</li> <li>• Finger millet production are specific to agro-ecological zones and not all the Counties in Kenya grow Finger millet – Diversification of Finger millet</li> </ul>
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<p>Social conditions – Acceptability of the policies</p> <p>Environmental conditions – lack of a comprehensive land use policy</p> <p>Policy conditions – Lacking specific Finger millet policy</p>

	Market conditions - Poor market infrastructure
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	Development and dissemination – Supporting youth, females and males in production and marketing Finger millet Adoption and scaling – Supporting youth, females and males in production and marketing Finger millet
Gender related opportunities	Supporting youth, females and males in the production and marketing of Finger millet. Increased income by youth female and male Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	Development and dissemination – in access to markets by VMGs Adoption and scaling up - inaccess to markets by VMGs
VMG related opportunities	Supporting VMGs the production and marketing of Finger millet. Increased income by VMGs Increased employment by VMGs
<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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

## GAPS

### *Further research*

Adoption of policy options

Equity distribution among the stakeholders

Productivity levels among the smallholder farmers

Farmer accessibility to production inputs

<b>2.11.3. TIMP Name</b>	<b>Policy instruments related to Finger millet</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 existing policy instruments do not centralize the smallholder farmers' issues in finger millet production.

	Therefore, weak policy instruments lead to market failure for both inputs and outputs
What is it? (TIMP description)	Agricultural policy is implemented through instruments. Therefore, the policy instruments are the means to achieve policy objectives
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 related to finger millet production
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers Traders Processing industries Extension NGOs Research institutions Policy makers
Approaches to be used in dissemination	Meetings Radio Television Social media (What's App, Facebook, twitter) Internet Farmers' groups Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	Availability of policy objectives Availability of policy instruments Applied and adaptive Research to test, validate and release improved Finger millet varieties A platform for interaction in Finger millet value chain stakeholders
Partners/stakeholders for scaling up and their roles	Farmers – beneficiaries of policy instruments County extension staff - Sensitization of farmers NGOs – Sensitization of farmers Private sector (local traders and exporters) – beneficiaries Research institutions – Sensitization of stakeholders
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Disorganization and scattered farmers Small-scale farming Inadequate information to stakeholders on the agricultural policies whether National or County Poorly established Finger millet value chain

	Finger millet production are specific to agro-ecological zones and not all the Counties in Kenya grow Finger millet
Suggestions for addressing the challenges	Disorganization and scattered farmers – Formation of producer organizations as an institution Small-scale farming – Policies for increasing productivity <ul style="list-style-type: none"> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>• Poorly established Finger millet value chain – strengthening Finger millet value chain</li> <li>• Finger millet production are specific to agro-ecological zones and not all the Counties in Kenya grow Finger millet – Diversification of Finger millet</li> </ul>
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Low understanding of policy instruments Environmental conditions – lack of a comprehensive land use policy Policy conditions – Lacking specific Finger millet policy Market conditions - Poor market infrastructure
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Development and dissemination – Low Finger millet production by youth, females and males</li> <li>• Adoption and scaling – Market in access by youth, females and males</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Production-increasing by youth, females and males.</li> <li>• Increased resource use in agricultural production and processing by youth, women and men</li> <li>• Sustainability in Finger millet farming by youth, women and men</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Development and dissemination – Issues related to efficiency, factor markets, product markets by VMGs</li> <li>• Adoption and scaling up - Issues related to efficiency, factor markets, product markets by VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Efficiency and access to factor and product markets by VMGs.</li> <li>• Increased income by VMGs</li> <li>• Increased employment by VMGs</li> <li>• Sustainability</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

Requires validation, 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

### ***Further research***

Validation of policy instruments

Equity distribution among the stakeholders

Farmer accessibility to production inputs markets

Farmers accessibility to output markets

2.11.4. TIMP Name	Policy cycle
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Development of agricultural policies not relevant to the problem emergency in finger millet and also without staged follow-up.
What is it? (TIMP description)	The policy process is normally conceptualized as sequential parts or stages. These are (1) problem emergence, (2) agenda setting, (3) consideration of policy options, (3) decision-making, (5) implementation, and (6) evaluation. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. These individual steps provides a frame work and antedates any forthcoming issues related to policy development. The policy <i>cycle</i> is usually divided into five stages: agenda setting, formulation, implementation, and evaluation
Justification	Why is a policy cycle an appropriate tool for making policies related to finger millet? The policy cycle creates the need for a policy based on the agricultural problem emergence/issues. The policy cycle is an idealized 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 organizations 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 Television Social media (What's App, Facebook, twitter) Internet Farmers' groups Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP)
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> <li>• Applied and adaptive Research to test, validate and release improved Finger millet varieties</li> <li>• A platform for interaction in Finger millet value chain stakeholders</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> <li>• Policy makers</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	Machakos, Makueni, Kisii, Nyanza, Bungoma, Tharaka Nithi
Challenges in development and dissemination -	Disorganization and scattered farmers Small-scale farming Inadequate information to stakeholders on issues Poorly established Finger millet value chain
Suggestions for addressing the challenges	Disorganization and scattered farmers – issues on formation of producer organizations as an institution Small-scale farming – issues on aggregation Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages Poorly established Finger millet value chain – strengthening Finger millet value chain
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	Social conditions – Different issues among the Finger millet producers Environmental conditions – environmental issues

	Policy conditions – Lacking specific Finger millet policy Market conditions – Market issues
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Development and dissemination – generation of issues and implementation by the youth, females and males in production and marketing of Finger millet</li> <li>• Adoption and scaling – generation of issues and implementation by the youth, females and males in production and marketing of Finger millet</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Incorporation of issues generated by the youth, females and males.</li> <li>• Implementation of policy cycle</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Development and dissemination – Problems related to VMGs</li> <li>• Adoption and scaling up – implementation issues related to VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Reduction of VMGs problems in the production and marketing of Finger millet.</li> <li>• Involvement of VMGs in the implementation of policy</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	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

## GAPS

### *Further research*

Analysis of policy model

Impact on the new policy on Finger millet production and marketing



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