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

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DISCLAIMER

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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 Teff 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 Teff 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 Teff value chain. It is my hope that counties and other users will put this resource to good use as they transform and reorient their agricultural systems to make them more productive and resilient while minimizing GHG emissions under the new realities of the changing climate.

Francis Muthami
National Project Coordinator
Kenya Climate-Smart Agriculture Project

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ABBREVIATIONS AND ACRONYMS

AAK:	Agrochemicals Association of Kenya
AFA:	Agricultural Food Authority
AIP:	Agricultural Innovation Platforms
AMRI:	Agricultural Mechanization Research Institute
ASALs:	Arid and semi-arid lands
ASK:	Agricultural Shows of Kenya
CA:	Conservation Agriculture
CABI:	Centre for Agriculture and Bioscience International
CBOs:	Community Based Organizations
CCPs:	Critical Control Points
CGIARS:	Consultative Group for International Agricultural Research
CIAT:	International Center for Tropical Agriculture
CSA:	Climate Smart Agriculture
EABL:	East African Breweries Limited
EAGC:	East Africa Grain Council
FAO:	Food and Agriculture Organization
FFBS:	Farmer Field and Business Schools
FFS:	Farmer field Schools
FIFO:	First In First Out
FIPs:	Farmer Input Promotion
FPEAK:	Fresh Produce Exporters Association of Kenya
FSMS	Food Safety Management System
GAP:	Good Agricultural Practice
GHG:	Greenhouse Gases
GHP:	Global Health Partnerships
GMP:	Good Manufacturing Practice
HACCP:	Hazard Analysis Critical Control Points
ICM:	Integrated Crop Management
ICRAF:	International Council for Research in Agroforestry
IDM:	Integrated Disease Management
IFPRI:	International Food Policy Research Institute
ILC:	International Land Coalition
ILRI:	International Livestock Research Institute
IMM:	Integrated Manure Management
IPM:	Integrated Pest Management

IPM: Integrated Pest Management
ISFM: Integrated Soil Fertility Management
ITK: Indigenous Traditional Knowledge
IWM: Integrated Weed Management
KALRO: Kenya Agricultural and Livestock Research Organization
KBS: Kenya Bureau of Standards
KCEP-CRAL: Kenya Cereal Enhancement Programme Climate Resillient Agriculture Livelihoods Window
KCSAP: Kenya Climate-Smart Agriculture Project
KEPHIS: Kenya Plant Health Inspectorate Service
KESREF**:** Kenya Sugar Research Foundation
MoA: Ministry of Agriculture
MoALF&I: Ministry of Agriculture, Livestock, Fisheries and Co-operatives
MoALF: Ministry of Agriculture Livestock Fisheries
NARIs National Agricultural Research Institutes
NARS: National Agricultural Research Systems
NCPB: National Cereals and Produce Board
NGO's: Non-Governmental Organizations
PCPB: Pest Control Products Board,
POs: Producer Organizations
PPP: Public Private Partnerships
PRM: Participatory Range land Management
TIMP: Technologies, Innovations and Management Practices
ToTs: Trainers of trainers
TV: Television
US: United States
VMGs: Vulnerable and Marginalized Groups

1.0. Definition of terms and summary tables of Teff 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 and practices (seeding rates, fertilizer application rates, spatial arrangements, planting period, land preparation, watering regimes, etc.), protection methods, for crops; and feed rations, management systems, disease control methods, 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 Teff Value Chain

The inventory process identified 95 TIMPs comprising 32 technologies, 18 innovations and 45 management practices, distributed among the 12 sub-themes, as indicated in table 1.

Table 1: Summary of Teff TIMPs

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Teff	Improved teff varieties	10	0	0
Teff	Teff seed system	0	3	0
Teff	Food safety management system in teff	0	0	2
Teff	Teff agronomic management practices	0	0	4
Teff	Soil fertility management	1	1	2
Teff	Soil and water management	3	0	3
Teff	Teff crop health	2	2	20
Teff	Postharvest management	3	0	2
Teff	Teff value addition	5	11	0
Teff	Mechanization of Teff production activities	8	1	0
Teff	Teff farming business and marketing practices	0	0	8
Teff	Agricultural policy options	0	0	4
Total		**32**	**18**	**45**

1.3. Summary of Status of TIMPs in Teff Value Chain

The inventory process resulted in a total of 56 TIMPs that are ready for up-scaling, 35 TIMPs that require validation and 4 TIMPs that require further research in the sub-themes, as indicated in table 2.

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

Commodity/VC	Sub-Theme	Ready for up scaling	Require validation	Further Research
Teff	Improved Teff varieties	0	10	0
Teff	Teff seed system	1	2	0
Teff	Food safety management system in teff	2	0	0
Teff	Teff agronomic management practices	4	0	0
Teff	Soil fertility management	1	2	1
Teff	Soil and water management	5	1	0
Teff	Teff crop health	21	3	0
Teff	Postharvest management	3	1	1
Teff	Teff value addition	6	9	1
Teff	Mechanization of Teff production activities	8	0	1
Teff	Teff farming business and marketing practices	2	6	0
Teff	Agricultural policy options	3	1	0
Overall Total		**56**	**35**	**4**

Table 3: Inventory of Teff TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Improved Teff varieties	2.1.1 Marsabit 1 (TMSB 1)	Technology	Requires Validation
	2.1.2 Lusike white (TLW)	Technology	Requires Validation
	2.1.3 Marsabit 2 -1 (TMSB 2-1)	Technology	Requires Validation
	2.1.4 KisTeff 11 (T11)	Technology	Requires Validation
	2.1.5 Aila Red 2 (TAR 1)	Technology	Requires Validation
	2.1.6 : KIM 1 (TKIM 1)	Technology	Requires Validation
	2.1.7 KIM 2 (TKM 2)	Technology	Requires Validation
	2.1.8 KisTeff 2 (TKT 2)	Technology	Requires Validation
	2.1.9 KIB -26 (TKIB - 26)	Technology	Requires Validation
	2.1.10 KIB 27-1 (TKB 27-1)	Technology	Requires Validation
2.2 Teff seed system	2.2.1. Teff own seed selection	Innovation	Ready for up scaling
	2.2.2. Teff informal seed system	Innovation	Requires validation
	2.2.3. Teff formal seed system	Innovation	Requires validation
2.3 Food safety management system in teff	2.3.1 Hazard Analysis Critical Control Points (HACCP) Plan for Teff Value Chain in Kenya	Management practice	Ready for up scaling
	2.3.2 Good Agricultural Practices (GAP) for Teff	Management practice	Ready for up scaling
2.4 Teff agronomic management practices	2.4.1 Land preparation	Management practice	Ready for up scaling
	2.4.2 Planting Teff in rows	Management practice	Ready for up scaling
	2.4.3 Broadcasting using low seed rate	Management practice	Ready for up scaling
	2.4.4 Crop rotation for increased yield	Management practice	Ready for up scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.5 Soil fertility management	2.5.1 Integrated Manure Management (IMM)	Management Practice	Requires validation
	2.5.2 Integrated Soil Fertility Management (ISFM)	Management Practice	Requires validation
	2.5.3 Rapid soil testing services	Innovation	Requires validation
	2.5.4 Teff-legume intercropping	Complementary technology	Requires further research
2.6 Soil and water management	2.6.1 Contour bands	Technology	Ready for up scaling
	2.6.2 Bench terraces	Technology	Ready for up scaling
	2.6.3 Grass strips	Technology	Requires validation
	2.6.4 Participatory range managements	Management practices	Ready for upscaling
	2.6.5 Rain water harvesting systems (ponds and dams)	Management practice	Ready for up scaling
	2.6.6 Conservation Agriculture (CA)	Management practice	Ready for up scaling
2.7.1 Teff crop health	**2.7.1. Pests of Teff**		
	2.7.1.1 Integrated management of Fall armyworm (*Spodoptera frugiperda*) in Teff	Management practice	Ready for up scaling
	2.7.1.2 Integrated management of Bird Damage in Teff	Management practice	Ready for up scaling
	2.7.1.3. Integrated management of Stalk borer (*Busseola fusca*) in Teff	Management practice	Ready for up scaling
	2.7.1.4 Integrated management of shoot fly (*Atherigona soccata)* in Teff	Management practice	Ready for upscaling
	2.7.1.5 Integrated management of Red Teff worm *Mentaxya ignicollis* (Walker)	Management practice	Ready for up scaling
	2.7.1.6. Integrated management of Desert locust (*Schistocerca gregaria*) of Teff	Management practice	Ready for up scaling
	2.7.1.7. Integrated management of Welo Bush cricket in Teff	Management practice	Ready for up scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.7.1.8. Integrated management of termites in Teff	Management practice	Ready for up scaling
	2.7.1.9 Integrated Management of Teff Aphids	Management practice	Ready for up scaling
	2.7.2. Diseases of Teff		
	2.7.2.1.Integrated management of Loose smut and Seed smut diseases in Teff	Management practice	Ready for up scaling
	2.7.2.2.Integrated management of Sooty mold disease in Teff	Management practice	Ready for up scaling
	2.7.2.3 Integrated management of seedling blight (*Pythium, Rhizoctonia,Fusarium, Aspergillus)* disease in Teff.	Management practice	Ready for up scaling
	2.7.2.4 Integrated management of Leaf blight disease in Teff	Management Practice	Ready for up scaling
	2.7.2.5 Integrated management of Leaf Blast disease in Teff	Management Practice	Ready for up scaling
	2.7.2.6 Integrated management of Leaf Rust disease in Teff	Management Practice	Ready for up scaling
	2.7.2.7. Integrated management of Zonate eye spot disease in Teff	Management Practice	Ready for up scaling
	2.7.2.8 Integrated management of Head Smudge in Teff	Management Practice	Ready for up scaling
	2.7.2.9. Integrated management of Leaf spot disease in Teff	Management Practice	Ready for up scaling
	2.7.2.10. Integrated management of Damping off disease in Teff	Management Practice	Ready for up scaling
	2.7.3. Weed Management		
	2.7.3.1.Integrated Weed Management for Teff	Management practice	Requires validation
	2.7.3.2.Planting Teff innovatively in rows	Innovation	Ready for up scaling
	2.7.3.3. Competitive Teff Varieties to control weed	Technology	Requires validation
	2.7.3.4.Motorized Weeding	Technology	Requires validation

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.7.3.5 Crop rotation for increased yield	Innovation	Ready for up scaling
2.8 Postharvest management	2.8.1 Good harvesting methods	Management practice	Ready for up scaling
	2.8.2 Gotera (field drying of Teff)	Management practice	Requires further research
	2.8.3 Use of hermetic storage bags for storage	Technology	Ready for up scaling
	2.8.4 Metal Silo	Technology	Ready for up scaling
	2.8.5 Teff stores	Technology	Requires validation
2.9 Teff value addition	2.9.1 Teff flour	Innovation	Ready for up scaling
	2.9.2 *Injera*	Technology	Ready for up scaling
	2.9.3 *Kita*	Technology	Ready for up scaling
	2.9.4 *Fiqe*	Technology	Ready for up-scaling
	2.9.5 Teff cake	Innovation	Require validation
	2.9.6 Teff porridge	Innovation	Require validation
	2.9.7 Teff biscuit	Innovation	Require validation
	2.9.8 Teff Crackie	Innovation	Require validation
	2.9.9 Teff chapatti	Innovation	Require validation
	2.9.10 Mandazi	Innovation	Require validation
	2.9.11 Teff flour yoghurt thickener (for camel yoghurt)	Innovation	Require further research
	2.9.12 Whole-grain Teff breakfast cereal	Innovation	Ready for up scaling
	2.9.13 Teff beer	Innovation	Requires validation
	2.9.14 Teff Pop Product	Innovation	Require validation
	2.9.15 Teff Hay	Technology	Ready for up scaling
	2.9.16 Teff silage	Technology	Requires validation
2.10 Mechanization of Teff production activities	2.9.1 Power tiller	Technology	Ready for up scaling
	2.10.2. 4 Wheeled tractor	Technology	Ready for up scaling
	2.10.3 Mould board plough	Technology	Ready for up scaling
	2.10.4 Disc harrow	Technology	Ready for up scaling
	2.10.5 Seed driller	Technology	Ready for up-scaling
	2.10.6 Roller	Technology	Ready for up-scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.10.7 Motorized sprayer	Technology	Ready for up-scaling
	2.10.8 Reaper binder	Technology	Ready for upscaling
	2.10.9 Thresher	Innovation	Requires further research
2.11 Teff farming business and marketing practices	2.11.1 Transformative Model of production of Teff	Management practices	Requires validation
	2.11.2 Building a Business Plan for Teff production	Management Practice	Requires validation
	2.11.3 Contracted Teff production model	Management practices	Requires validation
	2.11.4 Collective marketing	Management practices	Requires validation
	2.11.5 Profitability analysis	Management practices	Ready for upscaling
	2.11.6 Market research for Teff farmers	Management practices	Requires validation
	2.11.7 Marketting innovation model	Management practices	Ready for up scaling
	2.11.8 Digital marketing	Management practices	Requires validation
2.12. Agricultural Policy options	2.12.1 National agricultural policy strategy framework	Management practices	Ready for up scaling
	2.12.2 Participation in County Integrated Development Planning	Management practices	Ready for up scaling
	2.12.3 Policy instruments related to Teff	Management practices	Ready for up scaling
	2.12.4 Policy cycle	Management practices	Requires validation
	Total TIMPs	**95**	

2.0 . DETAILED TEFF VALUE CHAIN TIMPS

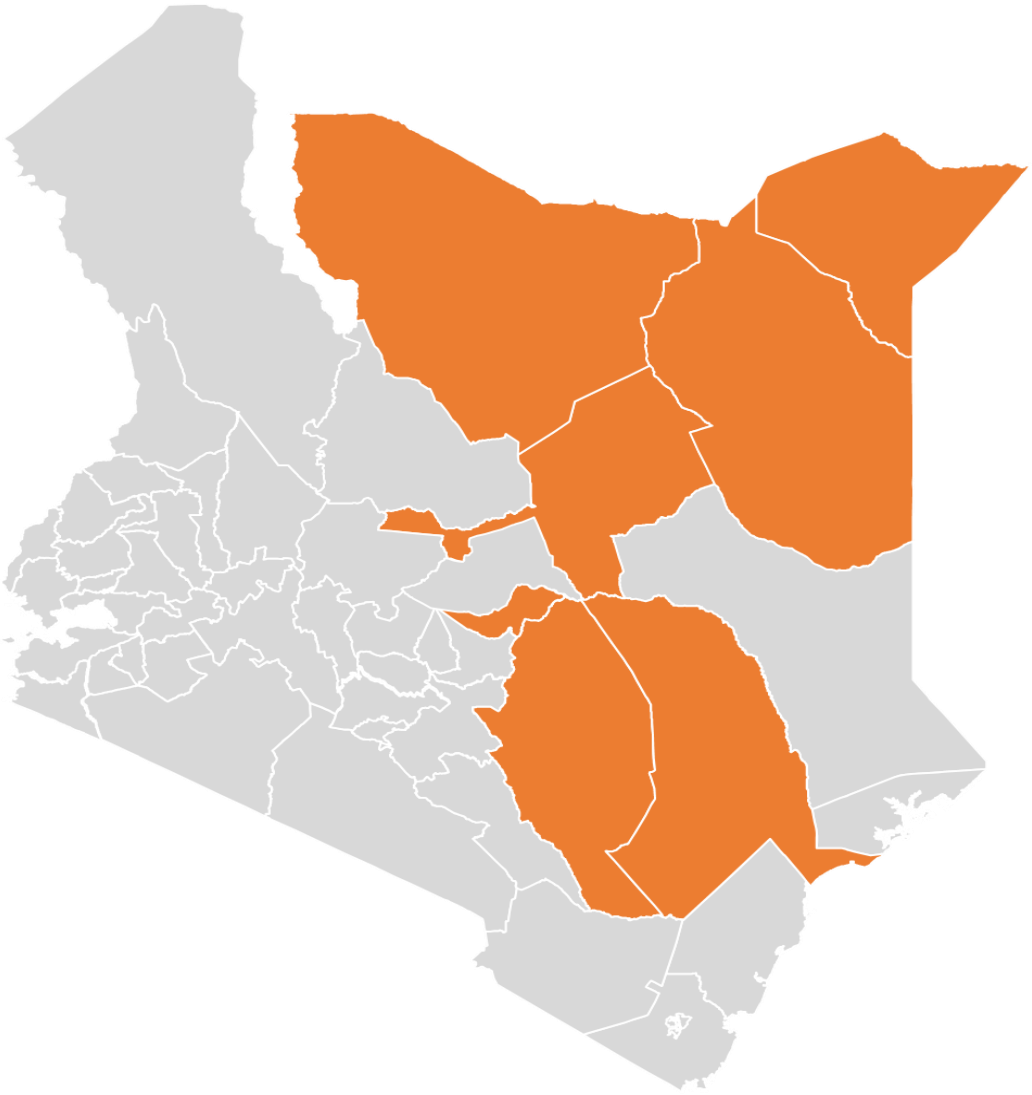

Figure 1 Suitability map of teff in Kenya

2.1. IMPROVED TEFF VARIETIES

2.1.1 TIMP Name	**Teff variety:** Marsabit 1 (TMSB 1)
Category (i.e. technology, innovation or management practice)	Technology   Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Teff farmers in Kenya do not have high yielding improved white varieties to increase the low yields of about 0.5 t/ha realized at farm level. This is because limited research and promotion of the crop has been undertaken and farmers are growing unimproved land races.
What is it? (TIMP description)	Marsabit 1 (TMSB 1) plant is medium in height with greenish yellow short semi compact panicles bearing cream white grain. The stems are green with brown nodes. The variety fowers ar 54 days after germination and matures early at 68 days (2.2 months). It has an average grain yield of 2.1 t/ha and biomass weight of 7.2 t/ha. Marsabit 1 has adapts well to areas with an altitude range of 250 -2500 meters above sea level.    Photo by: Kisilu R.K
Justification	With the widespread interest in the traditional high value crops, Teff (Eragrostis tef (Zucc.), being one of the most nutritive grains, is gaining interest in the rest of the world. Marsabit 1 has a broad adaptation growing at 250 -2500 meters above sea level. It can withstand high temperature up to 27^0C as well as highland low temperatures. With the high grain yield (2.1 t/ha) and biomass yield (7.2 t/ha) Marsabit 1 is not only important for human nutrition, but also as fodder for livestock. It is an important food security variety since it is very high yielding and climate resilient.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service.

Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALF&C) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption
	• Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favourable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated production cost: KES 31,000 per acre
Estimated returns	Grain yield: 720 Kg/acre @ KES 110 per Kg = KES 79,200 per acre. Grain returns =KES 48,200 Biomass Yield: 2,880 Kg/acre = 192 bales @ KES 400 = KES 76,800 Biomas returns= KES 45,800
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Labour intensity in planting, weeding, threshing which are mostly done by women and youth • Land ownership mainly by men who may have no interest in Teff • Financial empowerment, the poor farmers lack funds to acquire inputs

	• Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and other inputs such as varieties and seed • Reach more women groups with the Teff information • Well organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on Teff production
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some VMGs might not be able to participate in some agronomic activities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. There is need to come up with tailor made implements that meet the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • Teff activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased
VMG related opportunities	• Teff machines are affordable agricultural machines • There are simple friendly training materials with illustrations to enhance communication • Teff is in high demand hence the VMGs get good markets and high profits • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being

	cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior white Teff varieties
2. Analysis of the nutritional value of Marsabit 1 variety
3. Validation and promotion of the variety in the target areas of Teff cultivation

2.1.2 TIMP Name	**Teff variety:** Lusike white (TLW)
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	

Problem to be addressed	Teff farmers in Kenya do not have high yielding improved white varieties to increase the low yields of about 0.5 t/ha realized at farm level. This is because limited research and promotion of the crop has been undertaken and farmers are growing unimproved land races.
What is it? (TIMP description)	Lusike white plants are medium high with brownish semi compact panicles bearing white grain which is smaller than cream white grain. The stems are green with brown nodes and green leaf piths. It flowers 43 days after germination and matures early within 57 days (1.8 months). The variety has a grain yield of 2.0 t/ha and a biomass potential of 14t/ha. It is suitable for arid and semi arid areas with altitude of 250-3000 m asl.   Photo by: Kisilu R.K
Justification	Lusike white is a new Teff variety, it can be grown for its pure white colour which is preferred by many cereal consumers. The variety with relatively high yield and wide adaptation can be used to improve yields and increase the Teff cultivation area for increased productivity. This variety can grow in high altitude zones up to 3000 meters above sea level for grain production as well as fodder for pastoral communities in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALF&C) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's

Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop

	• Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 800 Kg/acre @ KES 110 per Kg = KES 88,000 per acre. Grain returns =KES 57,000 Biomass yield: 5,600 Kg/acre = 373 bales @ KES 400 = KES 149333 Biomas returns= KES 118,333
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Lusike white is a new Teff variety is labour intensity in planting, weeding, threshing which are mostly done by women and youth • Harvesting is tiresome for men for they have to bend or squats which is not easy for them • Land ownership is mainly by men who may have no interest in Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The variety is high yielding therefore will lead to increased productivity that will benefit all the gender categories (men, women and the youth) • The technology has high international and local demand therefore offers an opportunity for men and the youth who are mostly involved in marketing especially in far markets therefore generating more income

	• The variety is high yielding variety it will meet the food and nutrition security of all the gender categories in the household • There will be increased sales for women and youth • Proper timing of agricultural meetings/field days/seminars to enhance participation by all the gender categories as informed by daily /seasonal calendars
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some VMGs might not be able to participate in some agronomic Tactivities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. There is need to come up with tailor made implements that meet the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • Teff activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased production
VMG related opportunities	• The technology can improve food and nutrition security and an opportunity for increased income • This variety in high yielding hence will offer food security and nutrition for the VMGs • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1ready for upscaling;, 2-requires	Requires validation

validation; 3-requires further research**)**	
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
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Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior white Teff varieties
2. Analysis of the nutritional value for Lusike white variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.3 TIMP Name	**Teff variety: Marsabit 2 -1 (TMSB 2-1)**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low number of high yielding improved brown Teff varieties to increase the low yields of about 0.5 t/ha realized at farm level. This is because limited research and promotion of the crop has been undertaken and farmers are growing unimproved land races.
What is it? (TIMP description)	**Marsabit 2-1** is a medium to tall plant with golden brown panicles bearing dark brown coloured grain. The stems are green with brown nodes. It is a drought, heat tolerant and very early maturing variety. It fowers at 39 days after germination and reaches full maturity at 53 days (1.7 months). The

	grain yield is 1.8 t/ha while the biomass yield is 8.3 t/ha. Marsabit 2-1 is can grow within in 0 -2500 meters above sea level with temperature up to 34^0C .   Photo by: Kisilu R.K
Justification	**Marsabit 2-1** is broadly adapted to a wide range of altitudes (0 -2500) m asl. Being abel to withstand high temperature of up to 34^0C at 900 m asl as well as highland low temperatures of below 10^0C makes it climate resilient. It is not only important for human nutrition, but also as fodder for livestock.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service.
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied Research to release improved Teff varieties • Development of agronomic practices for Teff • Identification of Agro ecological and climate requirements for cultivation • Seed availability and accessibility • Good seed system to ensure quality • Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key

Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 720 Kg/acre @ KES 110 per Kg = KES 79,200 per acre. Grain returns =KES 48,200 Biomass yield: 3,320 Kg/acre = 221 bales @ KES 400 = KES 88,400 Biomas returns= KES 57,400
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: Marsabit 2 -1 (TMSB 2-1) is labour intensive mainly in planting, weeding, threshing which are mostly done by women and youth • Teff variety: Marsabit 2 -1 (TMSB 2-1) increases workload for women who are already burdened by their domestic roles • Land ownership mainly by men who may have no interest in • Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• Women and youth will get employment at various nodes of the value chain • Adoption of the TIMP has the potential of offering food security and nutrition to household members • The profit from the teff will empower women and youth to acquire land and other inputs such as varieties and seed • Well organized gender friendly markets and marketing system hence high profits from the sale of teff
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some VMGs might not be able to participate in some agronomic activities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. There is need to come up with tailor made implements that meet the VMG's needs and concerns

	• The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • Marsabit 2 -1 (TMSB 2-1) Teff activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased production
VMG related opportunities	• The technology can improve food and nutrition security and an opportunity for increased income • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • It offers a good opportunity for income generation for the VMGs • The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Kisilu, R. K., Aila, Y., Kirigua, V.O., Wasilwa, L.

Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior brown Teff varieties
2. Analysis of the nutritional value for Marsabit 2 variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.4 TIMP Name	**Teff variety: KisTeff 11 (T11)**
Category (i.e. technology, innovation or management practice)	Technology  Photo by :Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low number of high yielding improved brown Teff varieties to increase the low yields of about 0.5 t/ha realized at farm level. This is because limited research and promotion of the crop has been undertaken and farmers are growing unimproved land races.
What is it? (TIMP description)	KisTeff 11(T11) is a medium height plant with white short panicles bearing white grain. The stems are green with green leaf piths. It flowers within 54 days and has a medium maturity of 68 days (2.1 months). The variety has a grain yield of 2.3 t/ha an a biomass yield of 10 t/ha. It grows at 250 – 2500 meters above sea level. 

	Photo by : Kislu R.K
Justification	KisTeff 11 (T11) has a broad adaptation to a wide range of altitudes, It can with stand high temperature up to 34^0C and low temperatures of below 20^0C. It is an important food security variety due to its climate resilience and high yield (2.3t/ha) .
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service.
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, • seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to promote Teff , do farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit • facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 920 Kg/acre @ KES 110 per Kg = KES 101,200 per acre. Grain returns =KES 70,200 Biomass yield: 4000 Kg/acre = 267 bales @ KES 400 = KES 106,800 Biomas returns= KES 75,800
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: KisTeff 11 (T11) is labour intensive in planting, weeding, threshing which are mostly done by women and youth • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Land ownership mainly by men who may have no interest in Teff

	• Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in Teff variety: KisTeff 11 (T11) value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• Empower women and youth to acquire land and other inputs such as varieties and seed • Reach more women groups with the Teff information • Well organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on Teff production
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some VMGs might not be able to participate in some agronomic activities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. There is need to come up with tailor made implements that meet the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • KisTeff 11 (T11) teff activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased
VMG related opportunities	• The technology can improve food and nutrition security and an opportunity for increased income • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household.

	• It offers a good opportunity for income generation for the VMGs • The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Kisilu, R. K., Aila, Y., Kirigua, V.O., Wasilwa, L.
Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior brown Teff varieties
2. Analysis of the nutritional value for KisTeff 1 variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.5 TIMP Name	**Teff variety: Aila Red 2 (TAR 1)**

Category (i.e. technology, innovation or management practice)	Technology  Photo by : Rachael R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production with farmers reaching 0.5t/ha at farm level and the limited land area under Teff cultivation needs to be addressed.
What is it? (TIMP description)	**Aila Red 2** has a medium to short plants with compact panicles bearing red grain. It is very early maturing flowering at 39 days after germination and maturing at 53 days (1.7 months). The variety is high yielding with a grain yield of 2.0 t/ha and a biomass yield of 11.1t/ha. It suited in areas with 250- 2500 meters above sea level  Photo by: Kisilu R.K

Justification	**Aila Red 2** has a broad adaptation to a wide range of climate condition, growing in 250 -2500 meters above sea level. The variety has high yield and can grow in hot dry areas. Cultivation of this variety will improve yields and increase the area under cultivation. This variety will be able to be grown in other areas such as Garrisa, Isiolo, Wajir, Mwingi and tharaka Nithi for grain production as well as fodder for pastoral communities in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption
	• Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization

	• Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Marsabit, Mandera, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitu, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 800 Kg/acre @ KES 110 per Kg = KES 88,000 per acre. Grain returns =KES 57,000

	Biomass yield: 4,440 Kg/acre = 296 bales @ KES 400 = KES 118,800 Biomas returns= KES 87,400
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: Aila Red 2 (TAR 1) is labour intensity in planting, weeding, threshing which are mostly done by women and youth • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Land ownership mainly by men who may have no interest in • Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The variety is high yielding therefore will lead to increased productivity that will benefit all the gender categories (men, women and the youth) • The technology has high international and local demand therefore offers an opportunity for men and the youth who are mostly involved in marketing especially in far markets therefore generating more income • Teff variety: Aila Red 2 (TAR 1) as high yielding variety it will meet the food and nutrition security of all the gender categories in the household • The variety being early yielding will offer stable supplies and markets for women and youth • There will be increased sales for women and youth • Proper timing of agricultural meetings/field days/seminars to enhance participation by all the gender categories as informed by daily /seasonal calendars
	• Some VMGs might not be able to participate in some agronomic activities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. There is need to come up with tailor made implements that meet the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs

	• VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • Teff variety: Aila Red 2 (TAR 1) activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased production
VMG related opportunities	• The technology can improve food and nutrition security and an opportunity for increased income • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
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Partner organizations	KALRO Marsabit, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior Teff varieties
2. Analysis of the nutritional value for Aila Red variety
3. Validation and promotion of the variety in the Teff cultivation target areas

4.

2.1.6 TIMP Name	Teff variety: KIM 1 (TKIM 1)
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production with farmers reaching 0.5t/ha at farm level and the limited land area under Teff cultivation needs to be addressed.
What is it? (TIMP description)	KIM 1 has short plants with long purple semi compact narrow panicles bearing white big sized grain. The variety flowers at 44 days after germinartion and matures early at 58 days (1.9 months). The variety is a moderate grain yield of 1.8 t/hand a high biomass yield of 11.6 t/ha. It is suited in areas with 250- 2500 meters above sea level. It is can store for 3 years because it does not get infested by storage pests.  Photo by: Kisilu R.K
Justification	KIM 1 Teff is a new elite variety with high yield and can grow in wide area from lower hot dry areas to upper cold dry areas. The variety grows in 250 -2500 meters above sea level. It can survive under high temperature. The grain is used for human consumption and the foliage as fodder for livestock. Cultivation of this variety will improve yields and increase area under Teff cultivation. This variety will be able to be grown in many areas such as Garrisa, Isiolo, Wajir, Mwingi and tharaka Nithi and Makueni
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption
Critical/essential factors for successful promotion	• Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new crop to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level.
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 720 Kg/acre @ KES 110 per Kg = KES 79,200 per acre. Grain returns =KES 48,200 Biomass yield: 4,640 Kg/acre = 309 bales @ KES 400 = KES 123,600 Biomas returns= KES 92,600
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: KIM 1 (TKIM 1) is a new variety and women might not be aware of the crop • Teff variety: KIM 1 (TKIM 1) is labour intensive in planting, weeding, threshing which are mostly done by women and youth • Harvesting is tiresome for men for they have to bend or squats which not easy for them

	• Land ownership mainly by men who may have no interest in Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers • There is need for having gender friendly training materials with illustrations to enhance communication to all gender •
Gender related opportunities	• KIM 1 (TKIM 1) teff variety is a multipurpose crop offering food security and nutrition for human and livestock for households • KIM 1 (TKIM 1) teff variety empowers women and youth to acquire land and other inputs such as varieties and seed from the funds accrued from its sale • There is increased employment for women and youth at various nodes of the variety value chain • Teff is in great demand offering high profits to women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• The VMGs have less access to resources such as land and credit to adopt the TIMP • VMGs have less access to extension services due to prejudice and their social status so they might not be aware of the KIM 1 (TKIM 1) teff variety • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and new seeds KIM 1 (TKIM 1) teff variety • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • KIM 1 (TKIM 1) teff has activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased production • Empower the VMGs by connecting them to financial sources
VMG related opportunities	• The technology can improve food and nutrition security and an opportunity for increased income • The variety is high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • It offers a good opportunity for income generation for the VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Kisilu, R. K., Aila, Y., Kirigua, V.O., Wasilwa, L.
Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior dual purpose Teff varieties
2. Analysis of the nutritional value for KIM 1 variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.7 TIMP Name	Teff variety: KIM 2 (TKM 2)
Category (i.e. technology, innovation or management practice)	Technology  Photo by : Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of enough improved varieties. Farmers plant their local varieties hence the yields are at 0.5t/ha at farm level.
What is it? (TIMP description)	KIM 2 has short plants with greenish purple stem, medium length purple loose panicles bearing brown grain. The variety floers at 46 days after germination and mautes early at 60 days (2.0 months) The grain yield is 2.1 t/ha and the biomass yield is 13.6 t/ha. It is suited in areas with an altitude of 0- 2500 m asl.   Photo by : Kisilu R.K

Justification	KIM 2 is a new elite Teff variety with high yield and can grow in wide areas from lower hot dry areas to upper cold dry areas in 0 -2500 meters above sea level. It can survive under high temperature of up to 34^0C. It also has a high fodder production for livestock. Cultivation of this variety will improve yields and increase the Teff cultivation area for increased productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption • Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication

	• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new teff crop variety to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grain yield: 840 Kg/acre @ KES 110 per Kg = KES 92,400 per acre. Grain returns =KES 61,400 Biomass yield: 5,440 Kg/acre = 363 bales @ KES 400 = KES 145,200 Biomas returns= KES 114,200

Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: KIM 2 (TKM 2) is labour intensive in planting, weeding, threshing which are mostly done by women and youth • Since it is a woman crop so it increases workload for women who have other domestic roles • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Land ownership mainly by men who may have no interest in • Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation • Teff activities are labour intensive and thus there is need for gender responsive mechanization/ labour saving interventions for increased production
VMG issues and concerns in development, dissemination, adoption and scaling up	• Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. Therefore, need to come up with tailor made implements that meets the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation
VMG related opportunities	• There will be increased employment for VMGs

	• As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • There is potential of having stable products of Green grams in the markets • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Kisilu, R. K., Aila, Y., Kirigua, V.O., Wasilwa, L.
Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior Teff varieties
2. Analysis of the nutritional value for KIM 2 variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.8 TIMP Name	**Teff variety: KisTeff 2 (TKT 2)**
Category (i.e. technology, innovation or management practice)	Technology

	 Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields (0.5 t/ha), limited area under Teff cultivation and lack of improved varieties at arid and semi arid areas
What is it? (TIMP description)	KisTeff 2 has medium plants with medium medium length light red semi compact panicles bearing cream white grain. The grain yield for KisTeff 2 is 2.0 t/ha with a biomass yield of 10.4 t/ha. The varity flowers at 44 days after germination and matures in early in 58 days (1.9 months) and it is resistant to teff rust. It suited in areas with and altitude of 250- 2500 meters above sea level  Photo by: Kisilu R.K
Justification	KisTeff 2 grows in a broad range of climate conditions from lower hot dry areas to upper cold dry zones at 250 -2500 meters above sea level. It can survive under high temperature of up to 28 ^{0}C. It has a high fodder yield and it is resistance to Teff rust. Cultivation of this variety will improve yields and increase the Teff cultivation area for increased productivity. This variety will be able to be grown in many areas such as Garrisa, Isiolo, Wajir, Mwingi and tharaka Nithi and Makueni.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption • Diversification of Teff food products through value addition • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
Partners/stakeholders for scaling up and their roles	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days

	• Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new teff crop variety to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas

	• Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre
Estimated returns	Grai yield: 800 Kg/acre @ KES 110 per Kg = KES 88,000 per acre. Grain returns =KES 57,000 Biomass yield: 4160 Kg/acre = 277 bales @ KES 400 = KES 110,800 Biomas returns= KES 79,800
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety: KisTeff 2 (TKT 2) is labour intensive in planting, weeding, threshing which are mostly done by women and youth • Teff is a womens crop hence it increases work for women who are already burdened by domestic chores • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Land ownership mainly by men who may have no interest in • Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The variety is high yielding therefore will lead to increased productivity that will benefit all the gender categories (men, women and the youth) • The technology has high international and local demand therefore offers an opportunity for men and the youth who are mostly involved in marketing especially in far markets therefore generating more income • As an early maturing and high yielding variety it will meet the food and nutrition security of all the gender categories in the household • There will be increased incomes for women due to increased sales resulting in women and youth empowerment
VMG issues and concerns in development, dissemination, adoption and scaling up	• Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. Therefore, need to come up with tailor made implements that meets the VMG's needs and concerns • The VMGs have less access to resources such as land and credit

	• VMGs have less access to extension services due to prejudice and their social status • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs • VMGs have less access to markets than the other gender categories • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation •
VMG related opportunities	• There will be increased employment for VMGs • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • There is potential of having stable products of Teff in the markets • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important in Ethiopia and Eritrea. It is now also being cultivated successfully in India, Australia, Germany, the Netherlands, Spain, and the US.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Kisilu, R. K., Aila, Y., Kirigua, V.O., Wasilwa, L.
Partner organizations	KALRO Marsabit, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior Teff varieties
2. Analysis of the nutritional value for KisTeff 2 variety
3. Validation and promotion of the variety in the Teff cultivation target areas

2.1.9 TIMP Name	Teff variety: KIB -26 (TKIB - 26)
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	There are few dual purpose teff varieties which can grow rapidly with very low moisture and under high temperature. There are few Teff varieties which can be grown for fodder as wll as garin production because majority of the available varieties are bred for grain production. Lack of livestock feed is a major constraint in the semi-arid and arid areas mainly in the pastoral communities of Northern Kenya counties. In addition, the varieties that can be grown for both grain and livestock fodder have a high lodging percentage lowering the fodder quality
What is it? (TIMP description)	KIB 26 has medium plants with red stem and numerous tillers growing in tufts having dark red panicles bearing white seed. The plant is erect and does not lodge. The variety has high biomass yield of 9.5 t/ha and grain weight of 2.2t/ha. It flowers at 44 days after germination and matures in early 58 days. It suited in areas with 0- 2500 meters above sea level

	 Photo by: Kislu R.K
Justification	KIB 26 is well adapted to a wide range of climate condition, growing in 0 -2500 meters above sea level. It is a dual purpose fast growing, high forage and grain yielding variety. Due to high ratooning ability, the foliage can be harvested multiple times during the growing season. Direct grazing is also possible because it recovers first, it combines excellent forage quality with high yield during a relatively short growing season.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption • Diversification of Teff food products through value addition

	• Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Mandera, Marsabit
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new teff crop variety to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems

Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 18000
Estimated returns	Grain yield: 880 Kg/acre @ KES 110 per Kg = KES 96,800 per acre. Grain returns =KES 65,800 Biomass yield: 3,800 Kg/acre = 253 bales @ KES 400 = KES 101,200 Biomas returns= KES 70,200
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff variety**:** KIB -26 (TKIB - 26) **is l**abour intensive in cutting of hay hence the farmers just leave the animals to graze mostly done by men • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Land and livestock ownership is mainly by men who may have no interest in fodder Teff • Financial empowerment, the poor farmers lack funds to acquire inputs • Slow information and awareness flow to female farmers due to academic levels • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The variety is high yielding therefore will lead to increased productivity that will benefit all the gender categories (men, women and the youth) • The technology has high international and local demand therefore offers an opportunity for men and the youth who are mostly involved in marketing especially in far markets therefore generating more income • As an early maturing and high yielding variety it will meet the food and nutrition security of all the gender categories in the household • There will be increased incomes for women due to increased sales resulting in women and youth empowerment

VMG issues and concerns in development, dissemination, adoption and scaling up	• Teff variety**:** KIB -26 (TKIB - 26) production is laborious for VMGs • Dissemination methods and documents that are not always easy for VMGs to understand or access • VMGs have financial constraints due to limited access to credit facilities
VMG related opportunities	• There will be increased employment for VMGs • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • There is potential of having stable products of Green grams in the markets • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Teff production has been very successful and economically important crop in the northern Kenya counties, Ethiopia and Eritrea. It is now also being cultivated successfully in South Africa, America, India, Germany, the Netherlands, Spain, Australia and Canada.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior Fodder varieties
2. Validation and promotion of the variety in the Teff cultivation target areas

2.1.10 TIMP Name	Teff variety: KIB 27-1 (TKB 27-1)
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Rachael R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of livestock feed is a major constraint in the semi-arid and arid areas mainly in the pastoral communities of Northern Kenya counties. There are very few fodder crops which can grow rapidly with very low moisture and under high temperature. There are few Teff varieties which can be grown for fodder production because majority of the available varieties are bred for grain production. In addition the varieties that can be grown for livestock fodder have a high lodging percentage lowering the fodder quality
What is it? (TIMP description)	KIB 27-1 has tall plants with numerous tillers growing in tufts. The panicles are grey when mature, long and semi loose in shape bearing brown seed. The plant is erect and does not lodge. The variety has high

	biomass yield of approximately 12.3 t/ha and a grain yield of 2.0 t/ha It is suited in areas with 0- 3000 meters above sea level Photo by: Kisilu R.K 
Justification	KIB-27 is well adapted to a wide range of climate condition, surviving under high temperature of up to 34^0C and also very low temperatures were the fodder yield will increase. KIB-27 is a fast growing, high dual purpose yielding variety. Due to first ratooning ability, the foliage can be harvested multiple times during the growing season. It is also suitable for direct grazing.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Traders, Millers, Seed dealers, Researchers, Extension service, consumers
Approaches to be used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows and exhibitions • Public (MOALFC) and private (NGOs, service providers, traders, community workers) extension bodies • Farmer research networks • Farmer to farmer • Mass media (e.g.T.V and radio agricultural programs) • Social media and farmer digital platforms (e.g. KALRO mobile Apps), • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of agronomic practices for Teff • Good seed system to ensure quality availability and accessibility of seed • Adaptive research to identify the various areas for cultivation for each, create awareness and promote adoption • Diversification of Teff food products through value addition

	• Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Teff varieties
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide variety, seed and production information • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Being a new teff crop variety to majority of farmers hence low awareness of teff cultivation in most parts of Kenya • Low awareness of released varieties • Low use of agronomic practices • Labour intensity in planting, weeding, harvesting and threshing. • Unorganized marketing channels • Lack of quality seed • Limited processing technologies and consumption diversity at the household level
Suggestions for addressing the challenges	• Information dissemination on the improved variety and production practices • Promotion of the variety in the suitable areas • Mechanize Teff production • Promote marketing models that encourage collective production and marketing • Develop good policy for the Teff crop

	• Involve County governments, extension, marketers and processors • Promote value addition and consumption in local food systems
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of the varieties • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Farmers willingness to adopt , cultivate and consume the teff variety in the ASALs • Favorable weather conditions in the target promotion areas • Implementation of enabling and favorable policy such market price, seed policies and value addition policy • Teff markets are developed and maintained
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 18000
Estimated returns	Yield: 800 Kg/acre @ KES 110 per Kg = KES 88,000 per acre. Returns =KES 57,000 Biomass yield: 4,920 Kg/acre = 328 bales @ KES 400 = KES 131,200 Biomas returns= KES 100,200
Gender issues and concerns in development ,dissemination, adoption and scaling up	• **Teff variety:** KIB 27-1 (TKB 27-1) is labour intensive for women. Men also come in in cutting hay for livestock or sometimes livestock are left to feed freely in the farms after harevest. • Harvesting is tiresome for men for they have to bend or squats which not easy for them • Financial empowerment, the poor farmers lack funds to acquire inputs and to pay for hired labor • Slow information and awareness flow to female farmers due to academic levels • Lack of youth opportunities in in Teff value chain • The training materials and strategies are not favorable to women farmers
Gender related opportunities	• The variety is high yielding therefore will lead to increased productivity that will benefit all the gender categories (men, women and the youth) • The technology has high international and local demand therefore offers an opportunity for men and the youth who are mostly involved in marketing especially in far markets therefore generating more income • Teff variety**:** KIB 27-1 (TKB 27-1) is high yielding variety it will meet the food and nutrition security of all the gender categories in the household • There will be increased incomes for women due to increased sales resulting in women and youth empowerment

VMG issues and concerns in development, dissemination, adoption and scaling up	• Teff variety**:** KIB -26 (TKIB - 26) production is laborious for VMGs • Dissemination methods and documents that are not always easy for VMGs to understand or access • VMGs have financial constraints due to limited access to credit facilities • Not recognizing VMG's as farmers, when designing TIMPs such as the farm implements. Therefore, need to come up with tailor made implements that meets the VMG's needs and concerns • The VMGs have less access to resources such as land and credit • VMGs have less access to extension services due to prejudice and their social status which acts as a barrier for them to get the new technologies • VMGs have Limited access to improved inputs such as seeds, fertilizer/ manure and other inputs farm inputs • Strict rules of entry and requirements of producers' organizations may limit VMG 's participation
VMG related opportunities	• There will be increased employment for VMGs • As an early maturing and high yielding variety it will meet the food and nutrition security of the VMGs in whole household. • There is potential of having stable products of Green grams in the markets • It offers a good opportunity for income generation for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important in Ethiopia and Eritrea. It is now also being cultivated successfully in India, Australia, Germany, the Netherlands, Spain, and the US.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1. Research to release more superior fodder varieties
2. Analysis of the nutritional value for KIB 27 fodder
3. Validation and promotion of the variety in the Teff cultivation target areas

4.

2.2. TEFF SEED SYSTEMS

2.2.1 TIMP Name	**Teff own seed selection**
Category (i.e. technology, innovation or management practice)	Innovation  Photo by: Kisilu, R.K
A: Description of the technology, innovation or management practice	
Problem to be addressed	The formal seed system is not well established for the crop. Teff farmers grow Teff from grain harvested from the previous season. This method of recycling of seed has led to mixing, lower yields in every subsequent growing season and loss of quality and originality of the variety.
What is it? (TIMP description)	Own seed selection is a process of selecting quality seed from the farm before harvesting of the entire crop. Teff is a self-pollinating crop with a minimal cross pollination. This enables farmers to maintain their own variety through proper seed selection method. Own seed selection involves observation of health, true to type plants in the middle of the farm were pollen from other farms cannot reach. The selected plants are then harvested early and dried well. The plants are threshed and the seed stored in a dry, clean well ventilated place to be planted the next season. Own seed selection should only be practiced on one variety for a maximum of three seasons then the farmer should get certified seed
Justification	The selection of quality and high yielding seeds is very important in Teff grain and fodder farming. Training of Teff farmers in own seed selection method will ensure that the varieties will be maintained in a pure status and farmers will have good seed for longer before they are required to acquire certified seed from seed dealers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service.

Approaches used in dissemination	• On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of good seed systems to backstop own seed selection • Seed availability and accessibility through Teff research • Well organized farmer groups and networks • County and central government support • Funding to research, validate and promote new Teff varieties and seed production
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide varietie, seed and production information • Seed companies for quality seed multiplication • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges in dissemination	• Lack of quality seed due to the crop being a new • Low use of seed selection methods • Unwillingness of farmers to buy quality seed • Low awareness of importance of Teff in most parts of Kenya
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties with quality seed

	• Information dissemination on importance of using good seed to increase yield • Train farmers on seed selection and empower their ability to access seed • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. . • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000
Estimated returns	Average own seed yield: 400 Kg/acre @ KES 200= KES 80,000 Own seed returns: KES 49,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Teff stakeholders have been using poor quality seeds/recycled due to lack of established seed system for the crop • Selection of farmers own seed was initiated to assist farmers with quality seeds for teff and it is labor intensive especially for women whose work is complicated by their domestic roles • Selection of own seeds depends on land ownership for all genders • Women have limited access to productive resources such as land so they might not be able to adopt the TIMP • Women have limited access to agricultural and extension services hence they might not have adequate knowledge on quality seed selection procedures • Women might not be able to understand the teff written protocols due to illiteracy • Men are the land owners and they might not have no interest in teff since it is perceived as a women's crop • Selection of teff seeds is laborious for women and they might not understand the benefits of the selection • The training materials and strategies need to be favorable for all gender
Gender related opportunities	• Training of Teff farmers in own seed selection method will ensure that the varieties will be maintained in a pure status and farmers will have

	good seed for longer before they are required to acquire certified seed from seed dealers • Teff selection has the potential of increasing production for women and youth • The TIMP has the potential of improving food security and nutrition for families
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs teff farmers have been using poor quality seeds/recycled due to lack of established seed system for the crop • VMGs have limited access to productive resources such as land so might not be able to adopt the TIMP • VMGs have limited access to agricultural and extension services hence they might not have adequate knowledge on quality seed selection procedures • VMGs might not be able to understand the teff written protocols due to illiteracy • VMGs might not understand the benefits of seed selection since they are usually left out when important decisions are being made relating to agricultural information • The training materials and strategies need to be favorable for all farmers
VMG related opportunities	• Training of Teff farmers in own seed selection method will ensure that the varieties will be maintained in a pure status and farmers will have good seed for longer before they are required to acquire certified seed from seed dealers • Teff selection has the potential of increasing production for VMGs • The TIMP has the potential of improving food security and nutrition for VMG families
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important in Ethiopia and Eritrea. It is now also being cultivated successfully in India, Australia, Germany, the Netherlands, Spain, and the US.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

1. Lack of Teff certified seed
2. Lack of well-organized seed production, multiplication and delivery system

2.2.2. TIMP Name	**Teff informal seed system**
Category (i.e. technology, innovation or management practice)	Innovation  Source: Kisilu R. K
A: Description of the technology, innovation or management practice	
Problem to be addressed	Teff seed systems are not well established and this has hindered promotion of the crop to the target areas. Promotion of Teff to farmers in the various counties requires enough seed to reach the targeted number of farmers. The weak Teff formal seed system has not be able to achieve the quantities of the seed which are required.
What is it? (TIMP description)	Informal seed system involves community seed bulking which is a process of engaging selected individuals or farmer groups to multiply Teff seed under technical supervision following seed multiplication guidelines. The seed multiplied can be used in promotion of Teff varieties through recruitment of more farmers' groups and in that way create more awareness.
Justification	The selection of quality seed is important in Teff grain and fodder farming. In order to reach more farmers with the available Teff varieties, therefore there is need for informal seed system which will involve community seed bulking
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service.
Approaches to be used in dissemination	• On farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days • MoA/Extension officers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of good seed systems to backstop community seed bulking • Seed availability and accessibility through Teff research • Well organized farmer groups and networks • County and central government support • Funding for research, validation and promotion of new Teff varieties and seed production
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide varieties, seed and production information • Seed companies for quality seed multiplication • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to organize and mobilize farmer groups and assist them acquire seed • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui , Makueni
Challenges in dissemination	• Lack of quality seed due to the crop being a new • Low use of seed selection methods • Unwillingness of farmers to buy quality seed • Low awareness of importance of Teff in most parts of Kenya
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using good seed to increase yield

	• Train farmers on seed production and empower their ability to access seed • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000
Estimated returns	Average bulked seed yield: 800 Kg/acre @ KES 200 = KES 160,000 Own seed returns: KES 129,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have been having low yields due to poor quality of seeds as they have been using recycled seeds • Teff production is labour intensive especially in planting, weeding, threshing which are mostly done by women and youth • Land is owned mainly by men who may have not have interest in teff production • Financial empowerment, the poor farmers lack funds to acquire seed • Slow information and awareness flow of new seed varieties to female farmers due to academic levels • The training materials and strategies are not favorable to women farmers • Markets /agro vets for clean seeds may not be available for women and their mobility is limited by their domestic roles • Men are not fully involved in the production of Pigeon peas as it is perceived to be a woman's crop
Gender related opportunities	• There will be increased production of teff leading to improved food and nutritional security for women and entire household • There will be increased employment for women and the youth • Women will get appropriate information relating to quality seeds

VMG issues and concerns in development, dissemination, adoption and scaling up	• Dissemination methods and documents that are developed for the TIMP are not always easy to understand or access by the VMGs • There is slow information and awareness flow of the TIMP to VMGs due to academic levels • Markets /agro vets for clean seeds may not be available for VMGs due to their limited mobility especially for those abled differently • VMGs have financial constraints so they are not able to purchase quality seeds • Limited access to production resources such as land, knowledge, information, extension training, credit and quality seed limit the adoption of the TIMP by VMGs
VMG related opportunities	• There will be increased production of teff leading to improved food and nutritional security for VMGs • There will be increased employment for VMGs • VMGs will get appropriate information relating to quality seeds
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important in Ethiopia and Eritrea. It is now also being cultivated successfully in India, Australia, Germany, the Netherlands, Spain, and the US.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

1 Lack of Teff certified seed
2 Lack of well-organized seed production, multiplication and delivery system

2.2.3. TIMP Name	Teff formal seed system
Category (i.e. technology, innovation or management practice)	Innovation  Source: KALRO
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of a well-established seed system has hindered promotion of the crop to the target areas. Promotion of Teff to farmers in the various counties to improve production will require enough quality seed and the weak Teff formal seed system will not be able to achieve the quantities of the seed which will be required.
What is it? (TIMP description)	Formal seed system is the process of producing seed starting from release of varieties, production of early generation seed, and certified seed up to the stage where the farmers can access it through seed merchants for planting. The main stakeholders in formal seed systems include breeders, seed companies and retailers among others.
Justification	The selection of quality and high yielding seeds is very important in Teff grain and fodder farming. The success of the Teff value in Kenya will require the establishment of a strong formal seed system and seed access channels for quality seed to reach the Teff farmer.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service.
Approaches to be used in dissemination	• On station research, on farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days • MoA/Extension officers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Development of good seed systems to backstop community seed bulking and own seed selection

	• Seed availability and accessibility through Teff research • Well organized farmer groups and networks • County and central government support • Funding for research, validation and promotion of new Teff varieties and seed production
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide varieties, seed and production information • Seed companies for quality seed multiplication • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up Teff e.g. Africa Harvest, Farm Africa for farmer organizing and mobilization • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garrissa, Tana river, Tharaka nithi, Kitui, Makueni
Challenges dissemination in	• Lack of quality seed due to the crop being a new • Low use of seed selection methods • Unwillingness of farmers to buy quality seed • Low awareness of importance of Teff in most parts of Kenya
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using good seed to increase yield • Train farmers on seed production and empower their ability to access seed • Develop good policy for the Teff crop • Involve County governments, extension, marketers and processors
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key

Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is an already "a climate change ready crop" due to its wide adaptation ability. . • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000
Estimated returns	Average certified seed yield: 840 Kg/acre @ KES 200 = KES 168,000 Certified seed returns: KES 137,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have been having low yields due to poor quality of seeds as they have been using recycled seeds • Teff production is labour intensive especially in planting, weeding, threshing which are mostly done by women and youth • Land is owned mainly by men who may have not have interest in Pigeon pea production • Financial empowerment, the poor farmers lack funds to acquire seed • Slow information and awareness flow to female farmers due to academic levels • The training materials and strategies are not favorable to women farmers • Markets /agro vets for clean seeds may not be available for women and their mobility is limited by their domestic roles
Gender related opportunities	• There is potential for quality seeds for women improving the quality of crop yields for women • There is increased production of Pigeon peas leading to improved incomes for women and youth • The is creation of employment for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Dissemination methods and documents that are not always easy to understand or access • Low access to seed sources by VMGs • Financial constraints by VMGs to purchase quality seeds • Limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Some of the agronomic practices are not easy for VMGs to undertake since they are laborious • VMGs may have limited access to finances to buy the required inputs such as quality seeds

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services than men
VMG related opportunities	• Well organized seed systems enable the VMGs to access quality seeds • There is improved quality of teff hence improved markets • There is increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Teff production has been very successful and economically important in Ethiopia and Eritrea. It is now also being cultivated successfully in India, Australia, Germany, the Netherlands, Spain, and the US.
Application guidelines for users	**Reference:** Bart Minten, Alemayehu Seyoum Taffesse, and Petra Brown. 2018. The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).*
F: Status of TIMP readiness (1-Ready for upscaling;, 2-Requires validation; 3-Requires further research**)**	Requires validation
G. Contacts	
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Lead organization and scientists	Kenya Agricultural and Livestock Research Organization (KALRO) Kisilu, K. R., Aila, Y., Kirigua, V.O., Wasilwa, L.
Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps Research Gaps

5. Lack of Teff certified seed
6. Lack of well-organized seed production, multiplication and delivery system

2.3. FOOD SAFETY MANAGEMENT SYSTEM IN TEFF

2.3.1. TIMP Name	Hazard Analysis Critical Control Points (HACCP) Plan for Teff Value Chain in Kenya
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The presence of chemical, biological and physical hazards in the Teff value chain in Kenya has a direct effect on consumer's health.. The hazards have direct economic consequences affecting families, communities and industries subsisting on the Teff value chain in Kenya. \ The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards due to heavy metal accumulations such as lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards may cause harm to the consumers of the value chain products.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Teff 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 Teff supply from biological, chemical and physical hazards into the hands of food management systems. It is designed to minimize the risk of food safety hazards by identifying the hazards, through establishing controls and monitoring them. Application of HACCP concept in the management of likely adverse health effects resulting from exposure to hazards in the Teff value chain, maintains and improves on trade and health of consumers and workers within and without Kenya borders.
Justification	Assurance of food safety through monitoring in the Teff value chain is the Hazard Analysis and Critical Control Points (HACCP) system is critical. The tool is incorporated into the Codex Alimentarius of the world the national public health food safety legislations of Kenya. Application of HACCP in all stages of the Teff 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 Teff value chain are identified through critical control points. This sets limitation values for monitoring so that action can be taken when the set point values of hazards are out of the defined range required. In this Teff value chain, the proposed FSMS that will be adopted, different hazards would be minimized in every phase of production, harvesting, processing, distribution and consumption making Teff grain safe for consumption by Kenyans. Key

	elements are identified and used or modified to reduce hazards formation in all steps of production to consumption.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• The entire Teff value chain will be evaluated by determining contamination hazards in primary production systems and available control methods for Chemical, physical and biological contaminants; • Knowledge on production and post-harvest systems, Experience in implementation of ICM and IPM; • Experience with principles and practice of HACCP, GAP, GMP and GHP; ○ Knowledge of the target market demands on safety. • This HACCP information generated and built on seven principles and actions that follow. • Conduct of hazard analysis and identification of preventive measures • Identification of critical control points (CCPs) • Establishment of critical limits for monitoring of each CCP • Establishment of corrective action in the event of a deviation from a critical limit • Establishment of record keeping o Establishment of verification procedures • This will be used by stakeholders to address the hazard problems along the Teff value chain in Kenya. Dissemination of this generated information is done through national and county level, common interest groups discussions, field days, exhibitions, radio, TV and social media (WhatsApp, Facebook, and Twitter).
Critical/essential factors for successful promotion	• For successful promotion of food safety management system through HACCP in the Teff value chain; • An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the Teff 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 Teff value chain actors for implementation in order to reduce hazards.
Partners/stakeholders for scaling up and their respective roles.	• Institutions with IPM and ICM programs • Institutions responsible for legislating in food safety, regulations and sale of pesticides • Institutions with the required analytical testing • Training institutions with extension programs to producers and other actors on the chain • Producers and exporters associations.

	• County extension staff • Universities (Public and Private) • NGOs • Private sector • Processors and local traders
C: Current situation and future scaling up	
Counties where TIMPs will be up scaled	• All counties growing and consuming Teff in Kenya.
Challenges in development and dissemination	• Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	• Funding of dissemination platforms
Lessons learned in up scaling, if any	• The value chain of cashew nut 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 cashew nut value chain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Difficult to put monetary gains figures as most involves social and welfare issues in addition to markets lost due to non-compliance
Estimated returns	• Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women might not be aware of the health hazards associated with teff production • Women may not have time and mobility to attend trainings and other extension activities far from home or held at times when they are performing other domestic roles • Limited participation in decision making at the community and County level for women • In harvesting and processing teff to meet the acceptable national standards, women and youth play a critical role. • Capacity building women and youth in the identifications of food safety hazards/risks along teff value chain is called for.
Gender related opportunities	• Opportunities exist for women and youth in the marketing and use of teff and it's by products as an entrepreneurship. • There will be increased employment for women and the youth • There will be improved quality and production of teff leading to improved livelihoods for women and youth

VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to production resources such as land, knowledge, information, extension training, credit and quality seed. • Limited participation in decision making at community and County level • Require strategies that target the VMG during scaling up of the cotton value chain. • Need to review access and content of information and their channels to VMGs
VMG related opportunities	• Identification of critical limits to be defined • Control measures to be identified • Criteria for compliance already clearly defined for adoption • There will be increased employment for VMGs • There will be improved quality and production of cotton leading to improved livelihoods for VMGs
○ **E: Case studies/profiles of success stories**	
Success stories	N/A
Application guidelines for users	N/A
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
○ **G: Contacts**	
Contacts	Director General, KALRO Dr. Godwin Macharia - Centre Director, KALRO Njoro
Lead organization and scientists	1.Mr. John N. Ndung'u, FCRI - KALRO Njoro Mr. Athony 2.Nyaga, KALRO PTC 3.Dr. Francis Wayua, KALRO Kakamega 4.Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 5.Mrs. Violet Kirigua, KALRO Headquarters 6.Beatrice Wanjiku, KALRO Njoro
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.3.2. TIMPs name	Good Agricultural Practices (GAP) for Teff
Category (i.e. technology, innovation or management	Management practice
practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	The declining food safety, reduced food quality, sustainable farming practices, reduced environmental impact, worker safety and health, traceability are problems that should be addressed through good agricultural practice in teff farming
What is it? (TIMP description)	The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on farm standards. It is not about a specific crop production but the process through which production takes.
Justification	Good Agricultural Practice (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture (by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table but also upstream to include suppliers (e.g. fertilizers, plant protection) and all value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• All Teff 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 larger plot demonstrations Dissemination workshops • Field days and shows • Farmer to farmer communication • Brochures, factsheets and leaflets
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,
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	All counties in Kenya where Teff 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Difficult to put monetary gains figures as most involves social and welfare issues in addition to markets lost due to non-compliance
Estimated returns	• Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have less access to factors of production like land, information farm equipment and credit • Women have limited knowledge on GAPs due to limited agricultural information and extension • In most households, it is the men who make decision on what to do and how it is done • Women have been associated with low production of Teff • Women and youth usually left out when agricultural innovation groups are being left due to their social status they occupy in the society
Gender related opportunities	• Agro-enterprise development by youth, females and males based on GAPs • Increased income due to improved production income as a result of using GAPs by the youth, females and males • There is potential of stable income and livelihoods for women and youth as a result of using GAPs
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to GAPs

	• VMGs have less access to farmer organization due to their status in the society which makes them to be left out when these groups are being formed • VMGs have limited access credit to purchase the required GAPs • VMGs have limited access to training on GAPs and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination of GAPs • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• There is potential of improved employment for VMGs due to increased production as a result of application of GAPs • There is potential of stable income and livelihoods for VMGs as a result of using GAPs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	• Options for certification exist depending on weather it is a single holder certification or group compliance. • Compliance is a process and hence takes time and involves a process of continuous improvement. • No need for farm sophistication to adopt. • There is provision for taking corrective action for all noncompliance at time of assessment. • Requires continuous training and exposure to better systems.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	Officer in Charge KALRO – PTC, Centre Directors; KALRO FCRI Njoro, KALRO Marsabit, KALRO Katumani, Director General KALRO.
Lead organization and scientists	KALRO: Nyaga A., Ndung'u, J., Wayua, F., Wasilwa, L and Kirigua, V.
Partner organizations and their roles	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.4. TEFF AGRONOMIC MANAGEMENT PRACTICES

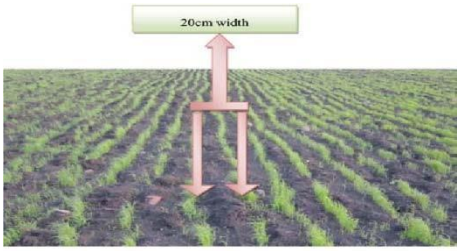
2.4.1. TIMP Name	**Land preparation**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yield due to improper land preparation
What is it (Timp description) 	Teff seeds are too tiny to survive under cloddy soil hence the technology involves breaking down of soil clods into fine particles, to enhance seed soil contact and for better moisture infiltration. Moreover, it will also enhance suppression of weeds and reduce nutrient competition.
Justification	Teff crop is important food stuff both for human consumption and livestock's however, the yield remains low due to improper land preparation. This is informed by poor germination, weed competition, low moisture infiltration which inhibit proper seed soil contact. Generally, farmers are hesitant in doing proper land preparation because of the perceived high cost. Adequate land preparation reduces yield loses and increases productivity due to proper land management. E
B: Assessment of dissemination and scaling up/out approaches	
• Users of TIMP	• Farmers, extension agencies, processing industry, seed producers and traders NGOs, faith based organization, CBOs and CIGs and VMGs
Approaches to be used in dissemination	• ToTs, Extension publications (leaflets, booklets, posters etc.) • FFBS • Local FM Radio Stations • Farmer group training • On-farm experimentation • Field day
	• Agricultural shows and trade fairs • Farmer to farmer communication

	• Plot demonstrations, small seed packets
Critical/essential factors for successful promotion	• Early and proper land preparation should be in place before the onset of rain. • Availability of ready market for the produce.
Partners/stakeholders for scaling up and their respective roles	Role of stakeholders • Capacity building of extension service providers (county government) • World vision; Educational exchange tours for farmers • Linking of farmers to the market • Providing farmers with certified seeds Kalro will train extension officers and lead farmers technical backstopping
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit
Counties where TIMPs will be upscaled	Marsabit, Mandera and Isiolo,Tana river,Wajir, Garissa, Tharaka Nithi,Meru, Kieni and part of coast regions
Challenges in dissemination	• Low publicity and awareness • Lack of facilitators and good trainers • Lack of mechanization • Lack of support from national/county government • Limited research inputs • Unpredictable weather conditions • Unavailability of certified planting material
Suggestion for addressing the challenges	• Enhanced publicity • Increased extension services • Increased research activities • Enhanced research extension linkages • Funds for Applied and adaptive research • Strengthening and capacity build extension
Lessons learned In upscaling	• An Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in northern Kenya stakeholder linkages and participatory implementation is important.
Social, environmental, policy and market conditions necessary for development and scaling	• Teff is currently considered globally as a super food. In Marsabit, it is socially acceptable and any technology to increase its production will be readily adopted. • Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased up take. • Existence of suitable bio-physical environments in target counties. • Availability of commodity market.

	• Linking the producers to international markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• The main input cost is the labour for *land* preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope /soil type/marasha plough/tractor driven plough however basic cost is Ksh 31,000.
Estimated returns	• Land preparation costs is about ksh 6,000; loses without good land preparation 2 bags of 90kgs @ ksh 9,900= 19,800 less ksh 13,800.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Teff farmers especially women have been having low yield due to improper land preparation • Poor land preparation has been leading to poor germination, weed competition, low moisture infiltration which inhibit proper seed soil contact • Land preparation is a laborious activity for women in addition it increase labour for women who are usually burdened by their domestic roles • Women have no finances to pay for hired labor • Teff farmers especially women are hesitant in doing proper land preparation because of the perceived high cost which they are not able to pay • Women have no control of teff farm implements for land preparation due to limited access to credit facilities • Teff land preparation implements are not gender sensitive and they are expensive for teff stakeholders especially women to purchase • Mechanization of land preparation activities will encourage women and youth to engage in teff land preparation activities
Gender related opportunities	• Create employment for the Youth especially in land preparation adoption of the TIMP will lead to increased production of teff leading to employment for women and youth • Mechanization of land preparation will attract all genders • Improved teff production will lead to increased food security and nutrition for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up;	• Land preparation is a labour intensive and laborious for VMGs to under take • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs

	• Lack of access to information will limit the VMG accessing and adopting the technology
VMG related opportunities	• Create employment for the VMGs in selling of teff products of Mechanization of land preparation will reduce labor for VMGs • Improved teff production will lead to increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar project	Good land preparation in research stations saw improved germination, good plant population and increased yield from less than 1 t/ha to more than 2 t/ha The practice should be validated on-farm to confirm results
Application guidelines for users	Teff extension training manual National research council1996 lost crop of Africa vol.1
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research R	Ready for up scaling
F: Contacts	
Contacts	Institute Director, KALRO-Marsabit; Po. Box 147-60500, Marsabit Cell: 0723-825-061; Email: ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Yussuf K Aila,, Kisilu R. K, Lusike Wasilwa, Molu sora,
Partner organizations	County government of Marsabit and local NGOS and CBOS

2.4.2 TIMP Name	**Planting Teff in rows**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low grain and bio-mass yield due to traditional method of sowing which results in competition between seedlings for water, nutrients and sunlight energy.
What is it? (TIMP description)	Planting Teff in rows spaced at 40 x drill inter and intra-row spacing, respectively. Planting is done by making furrows at the specified spacing, then drilling in manure, 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 and reduce competition for nutrients ,water and sunlight
Justification  *Figure 9. Teff row planting style.*	In row planting fewer seeds are used during planting compare to traditional method. Moreover, it reduces competition between seedlings for nutrients, water and sunlight. Row planting ensures uniform plant distribution and correct plant population. Routine farm operation will be carriedout with ease due to good spacing between plants which translates into increase yield by three folds on average and ensures lower seed cost. Although farmers are reluctant in adapting the technology because of the preceived intensive labour
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension agencies,researchers,CBOs,NGOs
Approaches to be used in dissemination	• On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations,TOT training
Critical/essential factors for successful promotion	• Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
Partners/stakeholders for scaling up	**Role of partners**. • County government and other extension service providers to strengthen farmer's capacity in promotion of technology • Kalro; will train county technical personnel and farmers on implementation of technologies • NGOs such as world vision, pacida Nawiri will provide inputs and capacity build the farmers. • Community farmer groups shall provide land for the purpose of demonstration.
C: Current situation and future scaling up	
County where Timp has been promoted (if any)	Marsabit county but there is potential of disseminating the same to the wider northern Kenya
County where Timp will be upscaled	Marsabit, Isiolo, mandera, wajir, Garissa, Tharaka, lower eastern and along the coastal regions.
Challenges in dissemination	• Labour intensive for small holder farmers • Time consuming; manual planting in rows is slow and takes quite a lot of time • Its expensive most smallholder farmers cannot afford

Recommendations for addressing the challenges	• Mechanization of teff farming through introduction of simple and cheap planters, harvester and threshers. • Farmers to form group and working together as it has been in the past (the Harambee spirit) • Government to subsidies price of farm equipment's and other inputs • Enhanced credit for farmers through linkages and affordable credit terms.
Lessons learned	• Row planting ensures optimum plant population and enhanced weeding operations, increased spike density tillering; it also increases biomass and grain yield and harvest index;
Social, environmental, policy and market conditions necessary	• Teff is socially acceptable and a high value crop. Any technology that enhances yield will be readily adopted. Awareness of the benefits of the technology will enhance acceptability for increased uptake. Enabling policy frame work e.g the Big 4 agenda that requires the blending of highly nutritive value food products. understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
D**: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	Ksh 31,000, cost of row planting is ksh 8,000.
Estimated returns	Without row planting the yield will reduce from 9 bags to 6 bags losing 3bags @ 9,900 = ksh 29,700 less the cost of row planting ksh 8000 comparative advantage of using the Timps is ksh 21,700
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the activities within the teff value chain hence increasing work for women • Women and youth have limited access to productive resources such as land, credit, and other inputs • Women and youth have limited access to education, training and extension services than men hence might not be aware of row planting of teff Women work is complicated by their multiple roles they do such as such domestic roles • Women might not be aware of the benefits of planting teff in rows and they might not support it since they might perceive the TIMP as adding more work to them • Women and youth have limited access to production resources such as land, capital to purchase equipment used for making rows

Gender related opportunities	• Employment opportunities for youth as service providers. • Planting teff in rows will make it easy to work in the teff farms for all genders • There would be increased production of teff hence improved food security and nutrition
VMG issues and concerns in development, dissemination, adoption and scaling up	• Teff row planting is labour intensive for VMGs to undertake especially for those abled differently • 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 Teff crop for the VMGs including value addition aspects. • VMG groups could have limitations in accessing the knowledge, resources for implementing teff row planting. • VMG have less access to extension training as they are not given equal opportunities so they might not be aware of the TIMP • VMGs have no finances to pay for hired labour due to limited access to credit facilities • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Employment opportunities for youth in row planting of teff. • Planting teff in rows will make it easy to work in the teff farms for all genders • There would be increased production of teff hence improved food security and nutrition
E: Case studies/profiles of success stories	
Success stories	Planting teff in rows at evaluation trials at KALRO Kiboko saw the yield increase from less than 1 t/ha to 2.3 t/ha
Application guidelines for users	Brochures are The Economics of Teff: Exploring Ethiopia's Biggest Cash Crop. *International Food Policy Research Institute (IFPRI).av*ailable for reference, teff extension training manual
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	KALRO- P.O box 147-60500, Marsabit

Lead organization and scientists	KALRO, Yussuf Aila, Kisilu R.K, Molu Sora, Lusike W. Odhiambo, Hottensia and Esilaba A.O.
Partner organizations	ICRISAT Nairobi; MoALF&I and County government

2.4.3. TIMP Name	**Broadcasting using low seed rate**
Category (i.e. technology, innovation or management practice)	Managements practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield due to poor method of farming
What is it? (TIMP description) 	As a solution, it is recommended to reduce the seed rates and to broadcast at a low rate Reducing the seed rate to 5-10 kg per hectare by mixing it with sand in order to reduce overcrowding and uneven distribution of plants between seedlings and allows for optimal Tillering or branching out of the plants. By reducing seed rate, land management and especially weeding can be done more easily. The incidence of lodging is also found to be reduced, as the stem of teff is stronger and has the ability to support the weight of the filled head of grain.
Justification	The potential of reduced seed rate technologies is to reduce problem of lodging and weak stems that cannot support the weight of filled head of grain. Reduced seed rate enhance productivity due to reduced competition for limited resources e.g. water, light and nutrients. This will also enhance tillering for increased yield productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Common interest groups and farmers.
Approaches used in developments dissemination	• Demonstrations, farmers field and bussiness schools and exhibition exchange educational tour, • TOT,extension publication e.g. brochures, leaf lets, posters
Critical/essential factors for successful promotion	• Create awareness among farmers and youth groups • Promoting the crop during chief barazas & meetings • Rapid campaign and lobbying through extension by influencing the eating habit of some pastoral communities • Training women and men groups on important

	• role of teff especially as resilient crop during this climate change phenomena and teff health nutritional benefits
Partners/stakeholders for scaling up	Partners Roles • Offer advisory services and backstopping (Kalro) • Provision of inputs (world vision, pacida, CG) • Farmers group will provide land for demonstration purposes.
C: Current situation and future scaling up	
County where Timp has been promoted if any	Marsabit county
County where Timp will be upscaled	Isiolo Wajir Isiolo, Wajir, Mandera, Makueni, Kitui Tana River (This are potential counties where trial are either ongoing or otherwise the agro-ecological is ideal for teff growth)
Challenges in dissemination	• Limited knowledge on the teff managements and practices. Limited support from national government county government and good national policy on special crops like teff. Labour intensive because it is unusual practices that demand more labour which is more often limited;
Recommendations for addressing the challenges	• Improved agronomic practices through capacity building of extension staff and model farmers and emphasis on the use farm machineries that ensure efficiency and reduced labour and achieving high returns.
Lessons learned	• Recommended seed rate will produce high yield in terms of grain and biomass production. • The use of farm machinery enhances efficiency and saves on time for proper management and increase yield • The use of mechanized teff thresher to separate seeds and stalks will reduce cost of labour and compensate for use of traditional oxens threshing. • Availing dual purpose teff varieties could encourage quicker adaptation of farming among the traditional pastoral communities.
Social, environmental, policy and market conditions necessary	• Capacity building of stakeholders and development of sound marketing policy. • Good policy especially on farm machinery subsidies

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 31,000
Estimated returns	Cost of planting seeds is reduced from 20kg/acre to 4kg/acre saving 16kgs by ksh 110 (ksh 1760). It will reduce yield by 1 bag @ 9900. Total lose when not using the Timp 9,900 + 1760 = ksh 11,660.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the planting activities therefore fetching sand to mix with teff seed may increase their work burden • Women and youth have limited access to productive resources such as land, credit, and other inputs so they might not be able to adopt the TIMP • Women and youth have limited access to education, training and extension services than men hence might not be aware of the TIMP • Women might not be aware of the benefits of planting teff mixing stones and seeds since they might perceive the TIMP as adding more work • Women and youth have limited access to production finances so they might not be able to hire labor in assisting broadcasting
Gender related opportunities	• Employment opportunities exist for women and youth in mixing sand and seeds during planting while planting • Employment opportunities for youth as service providers. • Applying the TIMP will reduced losses of seeds while broadcasting • There would be increased production of teff hence improved food security and nutrition
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land and credit. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Teff broadcasting is labour intensive for VMGs to undertake especially for those abled differently • 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 Teff crop for the VMGs including planting. • VMG groups could have limitations in accessing the knowledge, resources for implementing teff broadcasting as a planting method • VMG have less access to extension training as they are not given equal opportunities so they might not be aware of the TIMP • VMGs have no finances to pay for hired labour due to limited access to credit facilities
VMG related opportunities	• Employment opportunities for VMGs in broadcasting teff. • There would be increased production of teff hence improved food security and nutrition • There will be reduced losses of seed
E: Case studies/profiles of success stories	
Success stories	Broadcasting at low rate seed reduces seed rate from 10-15 Kg/ha to 5-10Kg/ha
Application guidelines for users	Teff brochures, fliers, modules and manuals are being developed; other reference material include National research council 1996 lost crop Africa vol. 1,
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Yussuf k Aila ; cellphone no ;0723825061 ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Yussuf Aila &Lusike Wasilwa
Partner organizations	MoALF&I in Counties CBOs,NGOs Women groups;

2.4.4. TIMP Name	**Crop rotation for increased yield**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of teff due to mono-cropping;
What is it? (TIMP description)	Crop rotation is a practice of planting of different crops sequentially on the same plot of land to improve on soil health optimize nutrients in the soil and break insect pest, weeds cycle. A basic principle of crop rotation is to avoid

	growing the same crop for consecutive years and principles of crop production is interchanging of tap root crops with fibrous root crops, leguminous with non-leguminous, avoidance of crop of same family follow one another to avoid pest and diseases build up. Different types of plants require different types of nutrients from the soil
Justification	Changing crops routinely allows the land to remain fertile, since not all of the same nutrients are being used each season. For example, planting a legume, such as soybeans, helps to replenish necessary nitrogen in the soil. Crop rotation can help to manage your soil fertility reduce soil erosion, improve your soil health and increase nutrients availability to plants.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers (farmers), extension agencies
Approaches to be used in dissemination	• Use of service providers, Tot, demonstrations, farmers tour
Critical/essential factors for successful promotion	• Farmers tour to gain knowledge from Ethiopia and Eritrea
Partners/stakeholders for scaling up	• County government of Marsabit, Non-governmen organization, faith based organization. And their roles are • Kalro offer advisory and backstopping services • Capacity building of extensions and farmers group • Provision of equipment's and other inputs. • Farmers provide land for trials.
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit County
Counties where TIMPs can be up-scaled	Marsabit, Mandera, Isiolo, Makueni, wajir, lower eastern counties and along the coastal regions.
Challenges in development and dissemination	• Low publicity • Limited support from the county government and national government • Inadequate technology and research inputs
Suggestions for addressing the challenges	• Enhanced publicity • Enhanced support from national and county government
Lessons learned in upscaling	• Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	• The teff farmers will be willing to change from their cultural teff practices and practice drop rotation

	• Teff rotation with other crops will improve soil fertility and reduce environmental degradation • Sound teff marketing strategies and policy will be implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 31,000
Estimated returns	Estimated loss is 1 bag equivalent to ksh 9,900.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the planting activities within the teff value chain increasing their work burden • Women and youth have limited access to productive resources such as land, credit, and other inputs so they might not be able to adopt the TIMP • Women and youth have limited access to education, training and extension services than men hence might not be aware of the importance of the TIMP • Men dominate most decisions at the household and community levels hence they determine whether crop rotation will be held for teff or not • Crop rotation will be determine to a larger extent by having access and control of land by teff stakeholders especially women
Gender related opportunities	• There is potential of improved productivity by women • There is potential of improved food security and nutrition for households • There is potential of increased incomes for women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and equipment hence they might not be able to adopt • VMGs have limited access to training and extension services hence they might not get information of the TIMP • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• There is potential of improved productivity by VMGs • There is potential of improved food security and nutrition for VMGs households

	• There is potential of increased incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Crop rotation in other cereals with legumes has been proved to improve the yield. This will also apply to Teff
Application guidelines for users	Teff brochures, fliers, modules and manuals National research council 1996 lost crop Africa vol. 1
F. Status of TIMP readiness: 1. Ready for upscaling; 2. Require validation; and 3. Require further research	Ready for up scaling
G: Contacts	
Contacts	KALRO-Marsabit; Cell: 0723-825-061; Email: ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Yussuf K. Aila, Kisilu. R, Molu D. Sora and Lusike Wasilwa,
Partner organizations	County government and local NGOS

2.5. SOIL FERTILITY MANAGEMENT

2.5.1 Technology name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields caused by land degradation characterized by the declining soil fertility, soil moisture stress, increased soil erosion and poor soil health. Well managed manure will supply macro and micro nutrients for enhanced crop production. GHG emissions, caused by poor manure management and handling leading Environment protection by minimizing leaching of nutrients
What is it? (TIMP description)	Manure Management is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops (and aquaculture). Manure can be in solid or liquid form, and is often mixed with crop residues and composted to enable decomposition. Proper manure management reduces emission of methane and carbon dioxide.
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are being depleted at annual rate of 22kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the (macro and micro) nutrients in manure reduces the amounts of additional mineral fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential of providing considerable amounts of limiting nutrients and improving the soil health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension workers, researchers
Approaches to be used in dissemination	• Open and field days • Exchange visits • Demonstration farms

Critical/essential factors for successful promotion	• Training on feeding, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using cereal crops
Partners/stakeholders for scaling up and their roles	• County governments- Provide extension services, farmer • mobilization and policy formulation • ILRI- technical backstopping • NGOs – micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Promoted for other crop in counties within Mt Kenya region, North and South Rift, but not promoted for Teff producing counties
Counties where TIMP will be promoted	Northern Kenya counties and all counties in the ASALs
Challenges in dissemination	• Lack of model demonstration farms • Cultural challenges -Lack of interest by pastoral communities • Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	• Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure preparation, storage and application
Social, environmental, policy and market conditions necessary for development and upscaling	• Social: Acceptability of manure as a resource for increasing agricultural productivity in pastoral communities • Environment: Knowledge and awareness creation on pathogens which can be harbored in the manure leading to disease outbreaks to livestock • Knowledge and awareness creation to reduce risk of propagation of invasive species when the seed is ingested by the animal and passed to crop field • Contamination of water sources by leaching of nutrients

	• Markets: Availability of markets and better prices as MM would result in increased output and quality • Policy: Policies that address manure management in relation to pathogens and environment (e.g. leaching, GHG emissions) • GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time Using locally available manure/composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns on teff value chain is high because of the low nutrient status of soils in the growing areas.
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of handling and application (often by broadcasting) hence may • disadvantage women
Gender related opportunities	• Manure is locally available for farm households with keep livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of handling and application hence may disadvantage VMGs. • The VMGs are also resource poor, hence may not have access adequate manures, e.g. need many livestock
VMG related opportunities	• Manure is locally available for those farm households with livestock and can build on what they already own
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	The guideline focus on the following areas: - Animal feeds: Feeding livestock with quality materials e.g. high protein concentrates will result in manures with a higher nitrogen content Livestock housing and manure collection Manure storage to preserve nutrient and avoid loses by covering to minimize losses through volatilization Timing of application for maximum utilization by the crop Installing anaerobic digestion for biogas production

	Regular analysis of manure to ascertain the quality Manure/Composts take a long time to cure, allow 2-3 months.
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations	County government, Private Public Partnerships

GAPS

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

2.5.2. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to declining soil fertility, low organic matter, poor soil structure and low soil moisture. Greenhouse gas emissions when manures are produced.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed combined to adapt practices to local conditions. It places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence).
Justification	Soils within the farming systems are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops.

	A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Training in workshops • On-farm visits • Farmer field schools (FFS) • On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Kiambu, Murang'a, Uasin Gishu, Elgeyo Marakwet
Counties where TIMP will be promoted	Marsabit , Isiolo, Mandera, Wajir and all ASAL counties
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	• For ISFM to succeed, good germplasm/seed/seedlings, etc. is required since farmers tend to re-use previous planted materials.

Social, environmental, policy and market conditions necessary	• Social: Acceptability of manure as a resource for increasing agricultural productivity in pastoral communities • Environment: Knowledge and awareness creation on pathogens which can be harbored in the manure leading to disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Markets: Availability of markets and better prices as ISFM would result in increased output and quality • Policy: Policies that address ISFM in relation to soil health and environment (e.g. leaching, GHG emissions in manures)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically demanding technology and high cost in areas where application of ISFM is non-responsive
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination adoption and scaling up	• Manual labor intensive in terms of handling and application (often by broadcasting) hence may disadvantage women • Decision on manure use and handling is dominated by men • Women lack appropriate knowledge on how to apply IMM in teff farms • There will be increased labor intensity for women involved in carrying and spreading manure in the farms • Men dominate in decision making as to manure preparation in the households.
Gender related opportunities	• Employment opportunities for youth males in manure preparation and handling • Women to form groups for selling manures • Men and youth males have opportunity to sell manure and earn income. • Women have employment opportunities in manure application. • Youth can form groups for collecting and selling Manure • Increased production of teff leading to improved livelihoods for women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs are physically disadvantaged for a practice that seeks to incorporate manures in the farm. • They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice. • VMGs have low adoption due to limited knowledge • VMGs have low access to training and manure The have limited access to resources such as credit to buy manure and other equipment used in handling manures • They have limited access to training and extension services on IMM

VMG related opportunities	• Manure is locally available for those farm households with livestock and can build on household incomes by selling it. • Increased production of teff leading to improved livelihoods for VMGs
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in sorghum and millet value chains in Machakos where productivity have been improved
Application guidelines for users	The guideline focus on the following areas:- Animal feeds Livestock housing and manure collection Manure storage to preserve nutrient and avoid loses Timing of application for maximum utilization by the crop Anaerobic digestion for biogas production Regular analysis of manure to ascertain the quality Manure/Composts take a long time to cure, hence need good planning prior to use MM is always site specific and users advised to only use information relevant to local circumstances
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa , S. Kimani
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

2.5.3. TIMP name	**Rapid soil testing services**
Category (i.e. technology, innovation or management practice)	Innovation

A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are not cheap to farmers, results take long and not are reproducible. The methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing using simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It requires partners involved (ICRAF, iSDA and SoilCares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension officers
Approaches to be used in dissemination	• Farmer visits • Training in workshops • Publicity campaigns done at County levels.
Critical/essential factors for successful promotion.	• Availability of the necessary equipment for rapid on the spot soil testing.
	• Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. • A well-designed storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data, and fertilizer recommendation according to crop type suitability). Availability a van to mount the equipment. • Farmers must understand, trust, and be willing to act upon the information provided

Partners/stakeholders for scaling up and their roles	• County government extension services; providing the link to farmers given that agriculture is devolved. • Soil Cares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and iSDA tests and validates the recommendation obtained in collaboration with Soil Cares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already promoted	Minimal reach at Nyeri County
Counties where TIMP will be up scaled	All the 24 KCSAP counties
Challenges in dissemination	• It requires continuous updating methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated pipelines for updating existing recommendation methods.
Lessons learned in upscaling if any	• Timely affordable soil information will guide on fertilizer use. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Boron.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Soil testing equipment and License, sampling and packaging materials (Kes 650,000/=), personnel and logistics (will depend on site/location).

	• Shipping selected soil and plant materials for further testing and results verification in a certified lab. • There are other additional costs on professional consultation.
Estimated returns	• Dependent on the enterprise adopting the service, but estimated at least 30% of current returns thus making agriculture a sustainable source of livelihood for entrepreneurs doing soil testing.
Gender issues and concerns in development, dissemination adoption and scaling up	• Teff stakeholders are not aware of Rapid social testing and its importance especially women • Women have limited access to agricultural information and extension services so they lack understanding of the TIMP • Women have no fiancés to pay for agricultural services such as Rapid soil testing due to limited access to credit facilities • By bringing services closer to the users saves time and resources to the farmers (men, women and youth) they will be able to utilize the service but they need to sensitized about it
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 will create employment for youths and women • There will be increased food security and nutrition for households.
VMG issues and concerns in development, dissemination adoption and scaling up	• The VMGs might not be aware of the TIMP due to illiteracy • VMGs are left out when important agricultural meetings and dissemination workshops are held relating to agricultural value chains • VMGs have limited access to agricultural and extension services • VMGs have no fiancés to pay for agricultural services such as Rapid soil testing due to limited access to credit facilities • 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 • There will be increased food security and nutrition for households.
E: Case studies/profiles of success stories	
Success stories	Has been tested used successfully by other organizations like ICRAF, Soil Cares & KESREF.

	It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.
Application guidelines for users	A handheld scanner to testing soils and crops in the field Community soil sampling champions are identified and trained on good soil sampling procedures. Soil and crop is analyzed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further	Requires validation
research)	
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and scientists	KALRO; C. Kibunja, A. Sila, D. Kamau, A.O. Esilaba, S. Kimani
Partner organizations	County governments in the 24 counties, Soil Cares, ICRAF and iSDA

1. **Research Gaps** 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.

2.5.4. TIMP name	**Teff-legume intercropping**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Low crop yields, hence low farm returns. Declining soil fertility, hence soil degradation. Soil erosion problems - runoff are minimized. Weeds infestation – manage using increased soil cover crops. Vulnerability to crop pests - practice helps slow the proliferation of pests and protect yields

What is it? (TIMP description)	Intercropping is the growing of two or more crops in close proximity (in the same row or bed, or in rows or strips that are close enough) for biological interaction. It also includes the growing of two or more cash crops together. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change. **Repellent intercrops,** an intercrop that has a repellent effect to certain pests can be used. This system involved the repellent crop masking the smell of the production crop in order to keep pests away from it.
Justification	Climate change is negatively impacting agricultural production. Farmers are experiencing low yields, crop failures, declined soil fertility and generally low farm returns from their investments. Intercropping is one of the potential management practices for enhancing climate change adaptation. It offers the potential to increase crop yield, enhance soil fertility/biodiversity and minimize the effects of climate change. The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single-crop environment. The practice has several advantages. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Secondly, crop mixtures frequently have lower pest densities, especially of insect pests. This occurs both because the mixture confuses the insects and, if chosen carefully attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension workers, Researchers and wide range of users
Approaches to be used in dissemination	• Demonstrations, Agricultural shows and Extension services
Critical/essential factors for successful promotion	• Awareness creation on the benefits and contribution of the practice to all stakeholders. • Easy access of legume varieties that are compatible with teff • Technical packages describing appropriate schedules of planting intercrop. • Package on fertilizer rates and regimes under the practice.
Partners/stakeholders for scaling up and their roles	• County governments – to provide extension services, farmer mobilization and policy formulation • NGOs – to provide support on capacity building and microfinancing services
C: Current situation and future scaling up	
Counties where already promoted	None

Counties where TIMP will be up scaled	All the Teff KCSAP Counties that will include Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, Marsabit, Garissa, Mandera and Wajir
Challenges in dissemination	• Limited access and wide distribution of certified seeds (intercrop varieties) • Inadequate access of technical materials on the establishment, operations and management of teff intercrop management practice by farmers • The increased effects of climate change hindering adoption. • Farmer high poverty levels coupled with illiteracy especially in deep rural areas of Kenya.
Suggestions for addressing the challenges	• Enhance access of clean planting materials across the counties. • Work closely with certified seed merchants, research institutions • Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. • Use farmer field schools and demonstrations • Develop a comprehensive manual on the practice to guide the farmers during the adoption
Lessons learned in upscaling, if any	• The practice is very important in pest management. Farmers can use a trap crop to attract pests, keeping them away from the main crop. Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs • The number of ecological benefits provided by this practice can also accelerate up scaling. Intercropping promotes interactions between crops and pollinators, thus supporting biodiversity and wildlife species.
Social, environmental, policy and market conditions necessary for development and upscaling	• Social: The TIMP will be accepted by both male and female gender. • Market: Teff and suitable legume intercrop seed will be available and affordable for the agropastoralists crop farmers. • Environmental: The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low-cost management practice though technically demanding especially but costs have yet to be determined.
Estimated returns	To be determined
Gender issues and concerns in development, dissemination	• Intercropping makes weeding and harvesting of teff complicated , these activities are usually done by women hence adding workload to women

	• Women have limited access to agricultural information and extension services so they might not be aware of the importance of the TIMP • Gender disparities in access to information may impact on adoption decisions. Access to information is a pre-requisite for informed decisions on adoption. • Women have got limited access to funding as compared to men so they might not have finances to purchase seeds used for intercrop • Men dominate in decision making of the farm enterprises in many communities • Land ownership is mainly by men who may have no interest in teff farming • There is slow information and awareness flow to female farmers due to their low academic levels.
Gender related opportunities	• Intercropping teff with legumes offers good opportunities to both men and women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits • The TIMP has the potential of increasing employment for women and youth • The TIMP has the potential of increasing food security for families
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited decision making power on land use may limit VMGs from adopting the TIMP • VMGs have limited access to agricultural information and extension services so they might not be aware of the importance of the TIMP • VMGs have got limited access to funding so they might not have finances to purchase seeds used for intercrop • VMGSs may not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intense and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for VMGs
VMG related opportunities	• Intercropping places emphasis on the importance of using available land space to grow a diverse of food, increase biodiversity, pest management thus the practice is economically viable. • Adoption of the TIMP increases food and nutrition security for VMGs • The TIMP leads to improved food productivity leading to increased incomes for VMGs
E: Case studies/profiles of success stories	

Success stories	Farmers have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice.
Application guidelines for users	Intercropping scheme is aimed at improving the overall economics of the farm. It is for this reason any new intercropping idea should first be tested on a relatively small area for evaluations Observe careful timing of field operations (sometimes necessitating special interventions) to keep competition between the intercropped species in balance A crop mix that works well in one year may fail the next if weather favors one crop over another. A mixture of crops with different growth forms or timing of development may make cultivation and use of mulches more difficult and less effective Planting crops in alternate rows or strips greatly simplifies management and captures some of the benefits of intercropping for pest control Intercropping poses a special problem for crop rotation. This is because if plants from two families are mixed in the same bed or field, achieving a substantial time lag before replanting either of those families may be difficult Intercropping requires extra care and effort in planning and maintaining a viable crop rotation.
F: Status of TIMP readiness (Ready for upscaling: Requires validation; Requires further research	Requires further research
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, P. Ketiem, E. Mutuma, M. Okoti, , D. Kamau, S. Kimani, C. Kundu and A.O. Esilaba
Partner organizations	County Governments, KCEP-CRAL project

Research Gaps

1. There are major information gaps on teff intercropping performances in specific areas of Kenya. For example, there hasn't been much research on intercropping teff and legumes in Kenya – there's therefore need for site specific validation.
2. There is little or no information on the suitable legume intercrops especially in the arid and semi-arid areas (ASALs).

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

2.6. SOIL AND WATER MANAGEMENT

2.6.1 TIMP name	**Contour bunds**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to the risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Contour bunds are stone or earthen walls built across a slope to prevent runoff.  Stone wall contour bund  Bunds constructed from earth walls Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus contour bunds resemble narrow channel terraces commonly referred to as "fanya chini" terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs). new bags every year. They can be used for multiple crops at different times.
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. 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. In Kenya, soil loss due to erosion is above the permissible limit of 2.2-10 t $ha^{-1}yr^{-1}$. Contour bunds decrease the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas cereal crops requiring less water, such as teff can be planted on the ridges.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension workers
Approaches to be used in dissemination	• Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct contour bunds. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	• County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	None for teff crop
Counties where TIMP will be promoted	Marsabit, isiolo, wajir, Mandela, Tharaka Nithi, Laikipia, Makueni, Kitui
Challenge(s) in development and dissemination	• Increased risk of soil erosion if contours are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of Contour for efficiency and increased output per man hour. • Training youthful farmers to be champions of Contour bunds construction at the Ward level/village level. • Training on site specific designs and construction of contour bunds • Fast-track land registration
Lessons learned, if any	• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.

Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County • level • Create awareness on the importance of soil and water conservation • Avail low-cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *contour* preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• Ownership of or access to land may limit women in some regions • Making decisions on land use may limit women in some region where decision making is men dominated • Differing accessibility of the technology and information may disadvantage different gender • The technology is labour intensive hence may disadvantage women and members who cannot procure labour services • 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. • Ownership of or access to land and credit will affect adoption and scaling up.
Gender related opportunities	• Increased agricultural production will increase access to food and income among all gender. • Potential for employment creation - youthful male and women will provide labour during the implementation of the technology.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited of access to information may limit the VMG from technology access and use • Limited attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges limits use of technologies. • The technology is labour intensive and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	• Application of contour ridge is expected to improve agriculture production thus, more food and income for the VGMs. • There will be increased food security and nutrition for VMGs
E: Case studies/profiles of success stories	

Success stories, if any	Not yet for teff
Application guidelines for users	Soil is excavated up-slope of the bund to a depth of 50 cm. Contour bunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400 to 500 m. The height of a bund should be at least 25 cm and have an approximate spacing of 1-2 m. In arid areas, the distance between bunds can be increased to 5-10 m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8 m across the slope.
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Governments extension offices.

Research Gaps

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

2.6.2. TIMP name	**Bench terraces**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields arising from the risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Bench terraces consist of a series of beds which are more or less level running across a slope at vertical intervals, supported by steep banks or risers

	(walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for Semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones  Bench terraces in Mbooni, Makueni County, Kenya .
Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension workers
Approaches to be used in dissemination	• On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct contour bunds. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	• County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	Marsabit and all the ASAL counties were growing of teff will be promoted

Challenge(s) in development and dissemination	• Increased risk of soil erosion if terraces are improperly laid out • Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour. • Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level. • Training on site specific designs and construction of bench terraces • Fast track land registration
Lessons learned, if any	• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Social: Create awareness on the importance of soil and water conservation • Avail low cost equipment for making soil and water conservation structures, • Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level • Policies: Policies that support individual land tenure systems will accelerate investments in soil and water conservation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *Bench terrace* preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Differing accessibility between men and women because of gender norms places access to new information and technologies in the hands of male heads of will affect adoption and scaling up of bench terraces. • Ownership of or access to land and credit will affect adoption and scaling up of bench terracing. • The misconception in some regions that teff is a woman's crop • Women and youth have limited access to productive resources such as credits to purchase farm implements. • Women and youth have limited access to education, training and extension services on bench terracing in teff farming

	• There is slow information and awareness flow to female farmers due to their low academic levels • The technology is labor intensive which might affect adoption by women. In addition it will increase the workload for women who are already overburdened by their domestic chores
Gender related opportunities	• Increased agricultural production will increase access to food and income among all gender. • Both men and women will provide labour during the implementation of the technology.
VMG issues and concerns in development and dissemination	• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • Bench terraces in labour intensive and laborious for VMGs to under take • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • Lack of access to information will limit the VMG accessing and adopting the technology
VMG related opportunities	• Application of bench terraces is expected to improve agriculture production thus, more food and income for the VGMs.
E: Case studies/profiles of success stories	
Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos; "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed. But when we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new technology for their crops"
Application guidelines for users	Terraces draining in one direction should run across the farm, and where farm size allows, they should be at least 100m or more. The length can be slightly increased in arid and semi-arid regions. The width of the bench (flat part) is determined by soil depth, crop requirements, and tools to be used for cultivation. Optimum width of terrace benches ranges from 2.5 to 5 m for manually constructed ones and from 3.5 to 8 m for machine built and tractor-cultivated ones. Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 0.5% in arid or semi-arid regions to 3% in humid regions with clay soils. Maximum gradients can be 5% for reverse terraces. In high rainfall areas (more than 1000 mm annually), it is necessary to make additional drainage provisions off the terraces – although this has a risk of causing erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.terraces – although this has a risk of causing

	erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; S. Kimani and D. Kamau.
Partner organizations	County governments extension offices.

2.6.3 TIMP name	**Grass strips**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields arising from the risk of soil erosion and increased run off
What is it? (TIMP description) 	Grass strips are dense rows or columns of grass panted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively good rainfall. The technology is suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and high rainfall areas
Justification	Agricultural production is threatened in many parts of the Kenya by soil moisture stress and serious soil erosion. Conservation of soil and moisture through construction of grass strips has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	• Farmers, extension workers, Researchers
Approaches to be used in dissemination	• On-farm demonstrations during farmer field chools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour • Availability of land, apart from cropland. • Farmers and extension service with skills to design and construct stone lines. • Land tenure systems that allows individual ownership
• Partners/stakeholders for scaling up and their roles	• County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	• Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	• Marsabit
Challenge(s) in development and dissemination	• Labour intensive for maintaining and controlling grass from becoming a weed • Reduced land area for crop production
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools and suitable grass varieties. • Capacity building on the maintenance of grass strips. Training on site specific designs and layout
Lessons learned, if any	• Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year. • Grass strips can be very appropriate for farmers who cut and carry fodder for their animals. • Grasses are also used as mulch for crops by farmers.
Social, environmental, policy and market conditions necessary	• Social: Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level

	• Policies: Policies that support individual land tenure systems • conservation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• The TIMP is labour intensive and may limit implementation by women adding more work to women who have multiple roles in the households • Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women • Limited ownership of or access to land may limit women from technology implementation • Limited power in making decisions on land use may limit women in technology adoption • 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 households will affect adoption and scaling up. • Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women • The misconception in some regions that teff is a woman's crop hence men have no interest in anything related to women and they are the custodians of agricultural information • Women and youth have limited access to education, training and extension services on establishing grass strips • Women have less access to agricultural information, technology and knowledge on grass strips • There is slow information and awareness flow to female farmers due to their low academic levels
Gender related opportunities	• The TIMP has the potential of increasing agricultural production leading to improved access to food and income among all gender. • The TIMP has the potential of increasing employment for youth and men during the implementation of the TIMP • Increased agricultural production will increase access to food and income among all gender.

VMG issues and concerns in development and dissemination	• Limited access to information will limit access to information and adoption • Limited decision-making power on land use may limit VMG in accessing and adopting the technology • May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intense and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	• Utilization of grass strips is expected to improve teff • Production thus more food and income for the VGMs. • There will be increased employment for VMGs
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Kenya are recording a yield increases and reduced soil erosion after embracing grass strips. The strips also offer fodder for livestock thus enhanced feed at household levels. The fodder is sometimes sold thus earning extra income.
Application guidelines for users	Spacing between grass strips depends on the slope of the land. It can be 20-30 m on gentle slopes and 10-15m on steep land. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. The grass needs to be trimmed regularly, to prevent shading and spreading to 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.
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and	KALRO,

scientists	E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, S. Kimani, C. Kundu and A.O. Esilaba.
Partner organizations	County governments extension service.

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

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

Lessons learned in upscaling, if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented.
Social, environmental, policy and market conditions necessary for development and upscaling	• Social: Create awareness on the importance of soil and water harvesting and conservation • Avail low-cost technologies for soil and water harvesting and conservation • Environmental: Create awareness to accelerate implementation of soil and water harvesting conservation at the County level • Policies: Policies that support individual land tenure systems • Conservation
	• Enact Policy frameworks to support water harvesting • Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Time saved fetching water from afar is channelled into other economic enhancing activities. Money used to treat diseases related to poor water hygiene is used for other activities. Healthy population will have energy to provide labour required in agricultural activities
Gender issues and concerns in development and dissemination	• Fetching domestic water is usually done by women , it is labor intensive since women walk long distances to fetch water • Fetching water adds more work to women who are already overburdened by their domestic chores • The distance from household need to be considered as women are the custodian of households in terms of domestic water demands. • The design of the water pans/storage should take care of the Occupation, Health and Safety of the communities • The technologies will reduce time needed to fetch water which will impact positively the women • Women and youth have limited access to productive resources such as credit to implement the TIMP • Women have less access to agricultural information, technology and knowledge on rain water harvesting

	• Men dominant most decisions at the household and community levels on rain water harvesting. • Men dominant most decisions at the household and community levels and such technologies like water harvesting
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	• Limited access to credit or financial services may limit access to technology • The land tenure systems may inhibit adoption of technology by the VMGs • Labour for making rain water harvesting structures may not favour VMGs • VMGs might not be able to make decisions relating to harvesting of rain water since they are usually left out when important decisions are being made in their localities • The have limited access to resources such as credit to buy implements for rain water harvesting • VMGSs have limited access to training and extension services on rain water harvesting
VMG related opportunities	• Develop SME opportunities around water harvesting. Also do small food gardens and tree nurseries around water pans • VMG maximize can engage in n availability of water to engage in small IGAs around water harvesting • Livestock too easily access water and their market value likely to appreciate • The technology will reduce the time used to search for water
E: Case studies/profiles of success stories	

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

Research Gaps

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

2.6.5. TIMP name	**Participatory Range Land Management**
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed	Low fodder productivity due to land degradation in range lands
What is it? (TIMP description)	Participatory Range land Management (PRM) is a systematic process that involves a series of activities including inventory of existing range resources, identification of the grazing unit, and implementation of range land management plan. The approach considers the indigenous knowledge of local resources and integrate it with the conventional range land restoration techniques
Justification	The climatic resilience and sustainability of range lands for many decades has been realized due to the management by pastoral groups who apply their rich indigenous knowledge and enforce local governance systems. However, the local customary institutions for managing grazing lands are being weaken by their less involvement in conventional restoration approaches as well as by the formation of new government administration and structures whose needs and aspiration are sometimes not in tandem with those of the local resource users. Consequently, important approaches for controlling range land degradation including the opportunistically herd mobility for across landscapes as well as the resting of degraded range lands, are becoming less applicable, resulting in rampant range land degradation and vulnerability of local range land users in the context of climate change. PRM has been found successful in restoration of degraded range lands since it exploits synergies in the integration of indigenous and conventional knowledge systems. The involvement of local resource users also make the approach sustainable and effective
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Pastoralist and agro-pastoralist communities
Approaches to be used in dissemination	• Use of traditional institutions for grazing control • Capacity building/strengthening of local grazing management institutions
Critical/essential factors for successful promotion	• Enough implementation time frame for successful restoration
Partners/stakeholders for scaling up and their roles	• County governments in ASALs • Community Initiative Facilitation Assistance • Center for Research and Development in Drylands
C: Current situation and future scaling up	
Counties where already promoted if any	• Low and high variable rainfall that limits quick restoration
Counties where TIMP will be promoted	• ASAL Counties

Challenges in dissemination	• Low and high variable rainfall that limits quick restoration
Suggestions for addressing the challenges	• Targeting of seasons/years of good/above average rains
Lessons learned if any	• Enhanced community resilience against climatic shocks.
Social, environmental, policy and market conditions necessary	• Local grazing institutions do not only help in managing grazing resource uses, but also useful in conflict resolutions and self- organization of pastoral societies at the time of difficulties
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women might not be aware of the TIMP and its importance due to limited access to agricultural information and extension services • Women have limited access to productive resources such as land , information and credit facilities • Circumvent the cultural norm of excluding women in the grazing management decisions by advocating for their participation.
Gender related opportunities	• Regeneration of community enclosures and other areas used by home-based herds have potential to increase production of teff hence increasing food security and nutrition for women and the youth • There is also potential of increasing income for women and youth from the sale of teff hence improving their livelihoods
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited decision making power on land use may limit VMG in accessing and adopting the technology • VMGs may not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • VMGs limited access to agricultural information and extension will hinder their awareness of the TIMP • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	• There is potential of improved food security and nutrition for VMGs

	• There is also potential of increasing income for VMGs from the sale of teff hence improving their livelihoods
E: Case studies/profiles of success stories	
Success stories	Participatory Rangelands Management in Kenya and Tanzania – Success story by International Land Coalition (ILC) after implementation of PRM since 2017: "By working together with national government ministries, local governments, non-governmental organizations, the civil society, and other stakeholders- PRM interventions are improving tenure security in all eight project pilot sites, contributing to securing over 246,770 hectares of rangelands, with 85,629 ha in Kenya and 161,144 ha in Tanzania
Application guidelines for users	• Identify range land resources, users and range land management institutions • Define range land management units and prepare range land resource assessment • Develop range land management plan and agreement • Arrest and reverse declining range land productivity • Participatory monitoring and evaluation **Reference** Flintan, F., Cullis, A., 2010. Introductory guidelines to participatory rangeland management in pastoral areas. Addis Ababa: Save the Children/US
F: Status of TIMP readiness (1=Ready for up scaling: 2=Requires validation; 3=Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Bulle Hallo Dabasso (PhD.) Tel. 0727 429 105 Email: bulledabasso@yahoo.com
Lead organization and scientists	KALRO, Bulle H. Dabasso, M. Okoti, S. Kimani, C. Kundu and D. Kamau
Partner organizations	County government, PPPs

2.6.6. TIMP name	Conservation Agriculture (CA)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed:	Low crop yields due to land degradation characterized by the declining soil fertility, soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	Conservation agriculture is an approach to farming in which the various practices follow key principles that target to conserve the soil, soil moisture, and soil- nutrients, and stabilise land production while reducing production costs. Conservation agriculture principles include minimal soil disturbance, permanent ground cover - maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops) and crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes. Conservation agriculture can sustainably increase crop yields
Justification	Crop yields are declining due to decreasing Land productivity. Continuous tillage continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to: • enhance management of soil fertility and organic matter, and improve the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer. • increase nitrogen-fixation through crop rotations and crop associations that include legumes; this contributes to optimum plant growth without increased GHG emissions induced by fertiliser production • minimise occurrence of net losses of carbon dioxide by microbial respiration and oxidation of the soil organic matter. This builds soil structure and biopores through soil biota and roots • shields the soil surface from heat, wind and rain, keeps the soil cooler and reduce moisture losses by evaporation through improved soil cover • reduce soil compaction and plough pans and regenerates degraded lands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	• Agricultural shows, Mass media, Chief's Baraza, Exhibitions, Farmer field Schools (FFS), On-farm and

	on-station demonstrations, Field Days, Extension Officers
Critical/essential factors for successful promotion	• Training on principles and benefits of CA • Model demonstration using crops
Partners/stakeholders for scaling up, their roles and stage of involvement	• County Extension officers - Dissemination of information, capacity building • NGO's (African Conservation Network, One Acre Fund)- Capacity Building, Dissemination of information • CIAT, FAO – capacity building • County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega
Counties where TIMP will be upscaled	Marsabit and all the ASAL Counties wher teff will be promoted
Challenges in dissemination	• Non-availability of crop residue in suitable quantities • Competition for crop residues with other uses like wood fuel and livestock • Land tenure (farmers reluctant to invest in CA where they do not have clear land rights) • Limited knowledge on the incremental benefits of CA • Limited access to CA implements
Suggestions for addressing the challenges	• Enhance Public Private Partnerships (PPP) to support increased production and market access • Improve KALRO and County government capacity to train and re-tool technical team so as to enhance uptake of the technology • Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA
Lessons learned in upscaling if any	• Uptake of CA technology increases with the realized incremental benefits over time • Continuous capacity building increases CA technology uptake
Social, environmental, policy and market conditions necessary for development and dissemination	• Environmental: Develop Integrated Herbicide Management Plan – pre-emergence and post-emergence herbicides • Social: Reliable technology adoption and suitable price and market access for produce under CA • Continuous capacity building of the community on the benefits of CA technology • Policy: Develop policies that support households investing in CA with inputs like implements

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase
Estimated returns	Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation Returns on conserving soil exceeding 20 ton/hectare annually and associated increased productivity
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women might not be aware of CA due to limited access to agricultural information and extension services • Women have no funds to purchase farm inputs and equipment used for the implementation of CA • CA is a management practice that that can be easily adopted by women • Reduces labor demands across all gender, hence good for all gender • Land ownership is mainly by men therefore reducing • wider adoption • Women are usually left out of decision making thereby reducing uptake
Gender related opportunities	• CA provides opportunities for enhanced food production with possible surplus for sale to generate income for women and youth. • CA has the potential of creating employment for women and youth during its implementation
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to CA inputs like planting implements may limit its adoption by the VMGs • Limited decision making power on land use may limit VMG in accessing and adopting the technology • VMGs may not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • VMGs limited access to agricultural information and extension will hinder their awareness of CA • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	• Opportunity to increase food production with surplus for sale can increase income and resilience for VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	When implementing the 3 principles of CA, one needs to note the following • Timely Operations - preparing the land in good time before the rains start; planting soon after an effective rainfall event; weeding at appropriate times and intervals; doing effective pest and disease control before either spread too widely. • Precise Operations - Precise measurements of row and plant spacing, evenness of depth and placement of soil amendments and covering of seed are also important. Planting should be done on the same lines each season • Inputs – Equipment, seeds, herbicides, manures/fertilizers – use the right inputs • Livestock - try to keep livestock out of the fields, even after harvesting the crop. **References** Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya. Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, E Mutuma, J. W. Wamuongo, M W. Gichuhi, S. Kimani, C. Kundu, A. Micheni, A.O. Esilaba and D. Kamau
Partner organizations	County government, Private Public Partnerships

Research Gaps

1. Identification of the most suitable diversified crop rotations and suitable crops for biomass for the different counties.
2. Development of suitable CA implements/field equipment prototypes.

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

2.7. TEFF CROP HEALTH

2.7.1. Pests of Teff

2.7.1.1. TIMP name	**Integrated management of Fall armyworm (*Spodoptera frugiperda*) in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Reduced yield of up to 70% due to infestation by fall armyworm  **African armyworm** (*Spodotera exempta*). Mature caterpillars measure up to 4 cm. (Source: © University of Arkansas)
What is it? (TIMP description)	Integrated management of the fall army worm includes the use of various pest control strategies. The strategies include cultural, biological and chemical control. **Cultural practises** • Scout the fields twice weekly, looking under the leaves and sheath areas for fall army worm larvae • Deep ploughing to expose pupae to sun light and predatory birds • Maintain field hygiene and plant flowering crop plants, viz.. *Tagetes spp*. Cosmos spp. etc. to attract the natural enemies. • Planting Napier grass/hybrid Napier in border and intercropping Teff with pigeon pea, cow pea in 2:1 to 4:1 ratio is advisable • Follow ridge and furrow planting method instead of flat sowing and erecting bird perches (@25/ha to encourage insectivorous birds soon after emergence. **Biological management** • Spray neem formulation (Azadirachtin, 1500 ppm) @ 5 ml/I or one lit/acre or 5%, Neem seed kernal extract (NSKE) immediately after observation of one moth/ trap/ day or 10 % plant infestation at early whorl stage.

	• Spray (Whorl application) *Bacillus thuringiensis* v. kurstaki formulations 2% @2g/l or *Metarhizium anisopliae* or *Beauveria bassiana* @ 5 g/ litter at 5-10% infestation. Repeat the spray based on weekly scouting at >10% fresh infestation. **Chemical management** • Seed treatment with Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml /kg seed for protection during seedling stage • Spray Belt 480SC, Prove 1.92 Emulsifiable Concentrate, MERIT 150 SC
Justification	African armyworm is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 70% have been experienced. Integrated management of African armyworm is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Watermelon farmers and consumers. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Most effective approaches	• Undertake applied and adaptive research to validate use of pheromone traps and other IPM technologies. • Create a platform for interaction of Teff value chain stakeholders on IPM technologies

	• Farmers adopt appropriate agronomic practices • Have well organized farmer groups and networks
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension/companies producing biological control and bio-pesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain

Suggestions for addressing the challenges	• Training farmers when to apply the intercropping crop types and promotion of conservation of biological agents to suppress various pests. • Establish Teff innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the pest. • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+ labour) Ksh 5,750
Estimated returns	Approximately Ksh 35,555. If IPM of Fall armyworm is not applied the yield will be reduced by 70%. Therefore, the estimated returns will be 35,555-24,888.50= **Ksh 10,666.50**
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IPM of fall armyworm due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of fall armyworm because they do not have finances due to limited access to credit facilities

	• Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of fall armyworm • IPM of fall armyworm is cheap and reduces production costs therefore user friendly to poor women • Where IPM of fall armyworm will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of fall armyworm protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of fall armyworm will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of fall armyworm will also lead to increased food security and nutrition for households • IPM of fall armyworm adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of fall armyworm is adopted.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of fall armyworm • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of pigeon pea diseases • There is low adoption by VMGs due lack of awareness

VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of fall armyworm will lead to improved productivity of pigeon pea hence more income for VMGs • IPM adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of fall armyworm is adopted..
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo

Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Explore bio-control options for controlling the fall army worm to minimize on pesticide use
2. Explore the efficacy of ITKs in management of fall army worm under high pressure

2.7.1.2. TIMP Name	**Integrated management of Bird Damage in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Reduce yield loss by 100% and quality of Teff grain.  **Birds: *Quelea quelea*** Source; planetbirds.blogspot.com
What is it? (TIMP description)	Integrated management of *Quilea quilea* bird in Teff applies the use of cultural, chemical and mechanical approaches. **Cultural practices** • Harvest grain Teff at soft dough stage maturity when color changes from green to cream white • Sun-dry the panicles to attain 11-12% moisture content. • Thresh the seed and store well. • Disturbing of birds with newly built nests or unhatched eggs to desert colonies • Harvesting of *quelea* for food directly from nests or indirectly catching flying adults under very small colonies • Planting of Napier grass *Pennisetum purpurum*, which act as 'trap roosts' where the birds can be controlled • Growing Teff cultivars having awns, large glumes and inverted heads can contribute in reducing losses **Chemical management** • Use of plant repellant from Cucurbitacae and Cruciferae families to repel *Quilea quelea* birds

Justification	Bird damage, is the major constraint, and it is the main reason why farmers shy away from Teff cultivation. It can lead to yield loss of between 60 and 100%. The integrated pest management practices for *Quelea quelea* sustainably reduces yield loss, is environmentally friendly and relatively safe to farmers and consumers of Teff
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Exporters, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on birds • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness.

	• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM practices • In adequate knowledge on IPM strategies on birds infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• Proper Information dissemination on the Teff early harvest technology to extension partners and farmers • Establish Teff innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations
Lessons learned in up scaling if any	• Adoption of good agricultural practices by farmers is key in management of the bird • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt management practice for the pest • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(labour) Ksh 2,000
Estimated returns	Approximately Ksh 35,555. If IPM of Bird (*Quelea quelea*) is not applied the yield will be reduced by 100%. Therefore, the estimated returns will be 35,555- 35,555= **Ksh 0**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of quelea quelea due to lack of access to agricultural information and extension services

	• Women and youth might not be able purchase the chemical used for IPM of *Quelea quelea* because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of *Quelea quelea* • IPM is cheap and reduces production costs therefore user friendly to poor women • Where IPM of *Quelea quelea* will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of *Quelea quelea* protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of *quelea quelea* will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of *Quelea quelea* will also lead to increased food security and nutrition for households • IPM of *Quelea quelea* adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of *Quelea quelea* is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of quelea quelea • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs

	• Adoption of IPM of *Quelea quelea* will lead to improved productivity of pigeon pea hence more income for VMGs • IPM of *Quelea quelea* adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM is adopted.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**Reference:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

1. **Research Gaps** Capacity building on Bird (*Quelea quelea*) identification and management
2. Validation of biopesticides and synthetic pesticides in the management of Bird (*Quelea quelea)*

2.7.1.3. TIMP Name	Integrated management of Stalk borer (*Busseola fusca*) in Teff
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 50% due to stalk borer infestation.  **Stalk borers:** African pink stalk borer (*Busseola fusca*), Source: Runetwork.org
What is it? (TIMP description)	Integrated management of the stalk borer applies various pest control strategies. The strategies include cultural, biological and chemical control. **Cultural practices:** • Planting Teff early • Plowing to break stubble and bury crop residues soon after harvest destroys overwintering larvae by exposing them to cold temperatures. • Handpick and destroy egg masses at seedbed and transplanting • Raise level of irrigation water periodically to submerge the eggs deposited on the lower parts of the plant • Apply insecticides to coincide with larval emergence so larvae are killed before they enter the rice stems • Apply pesticides judiciously to conserve natural enemies (wasps, ants, beetles, bugs, ants, birds, dragonflies, damselflies, and spiders) **Biological management** • Use pheromone (Selibate Cs, 40 g/ha100 microtubes/ha) immediately after transplanting to disrupt mating of moths • Apply *Bacillus thuringiensis* based products to control young larvae • Spray using different species of *Trichogramma* wasps against stalk borer eggs (100 trichocards/ha). Do it when infestation of moths is high. **Chemical management** • Spray with Lambda-cyhalothrin 17.5g/L (like Tata Umeme 2.5 EC, Duduthrin 1.75EC, Duduthrin super EC, Kingcode 5% EC, Pentagon 5% EC,Belt 480 SC

	• Spray deltamethrin 25 g/l (like Decis 2.5 EC, Deraphon Granules,
Justification	Stalk borer is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 50% have been experienced. Integrated management of Stalk borer is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers. Adoption of an IPM approach would enhance crop yields, food safety among the consumers and also contributes to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and bio-pesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect

	management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 5,750
Estimated returns	Approximately Ksh 35,555. If IPM of stalk borer is not applied the yield will be reduced by 50%. Therefore, the estimated returns will be 35,555-35, 17,777.50= **Ksh 17,777.50**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of stalk borer due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of stalk borer because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of stalk borer • IPM is cheap and reduces production costs therefore user friendly to poor women • Where IPM of stalk borer will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of stalk borer protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of stalk borer will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of stalk borer will also lead to increased food security and nutrition for households • IPM of stalk borer adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of stalk borer is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of stalk borer • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pest

	• There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of stalk borer will lead to improved productivity of pigeon pea hence more income for VMGs • IPM adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of stalk boreris adopted
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	Reference: • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

1. **Research Gaps** Explore bio-control options for controlling the stalk borers to minimize on pesticide use
2. Explore the efficacy of ITKs in management of stalk borers under high pressure
3. Validation of tolerance of new varieties to stalk borers

2.7.1.4. TIMP Name	**Integrated management of shoot fly (*Atherigona soccata)* in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 30% due to Teff infestation by the shoot fly.  Teff Shoot fly (*Atherigona soccata*) (Source; agrilearner.com)
What is it? (TIMP description)	Integrated management of the shoot fly applies cultural, biological and chemical control. **Cultural management**: • Scout the fields twice weekly, looking under the leaves and bud areas for pod borers • Remove and destroy or plough down crop residues from damaged plants in production fields • Use well decomposed manure to fertilize the field • Hand pick the grubs during tillage and kill them • Incorporate manure to promote plant vigour • Rotate/intercrop Teff with cotton, groundnut, sunflower • Weed fields since some weeds could serve as alternative hosts and harbour the pest season after season **Biological Management:** • Use neem based products e.g Nimbecidine, Neemroc 0.03% and Achook 0.15%. **Chemical management:** • Spray pyrethroid insecticide such as PENTAGON 50EC at 10ml/20l • Spray Emamectin benzoate 19g/l such as ESCORT 19EC at

	10ml/20l
Justification	Shoot fly is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 30% have been experienced. Integrated management of Shoot fly is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. Integrated Management of pests considers food safety concerns related to pesticide use and advocates for environmental conservation while lowering the total cost of Teff production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On farm demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer to farmer • Mass media – Agricultural programmes. • Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of

	enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other County with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 6,000
Estimated returns	Approximately Ksh 35,555. If IPM of shoot fly is not applied the yield will be reduced by 30%. Therefore, the estimated returns will be 35,555-35, 10,666.50= **Ksh 24,888.50**

Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of shoot fly due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of shoot fly because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of shoot fly • IPM of shoot fly is cheap and reduces production costs therefore user friendly to poor women • Where IPM of shoot fly will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of shoot fly protocols will not overburden any gender in implementation and are therefore has potential for adoption by both genqder
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of shoot fly will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of shoot fly will also lead to increased food security and nutrition for households • IPM of shoot fly adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of shoot fly is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of shoot fly • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of shoot fly will lead to improved productivity of pigeon pea hence more income for VMGs

	• IPM of shoot fly adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of shoot fly is adopted
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	• Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.1.5. TIMP Name	**Integrated management of Red Teff worm *Mentaxya ignicollis* (Walker)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 60% due to Teff infestation by red teff worm
What is it? (TIMP description)	Integrated management (IPM) of Red Teff worm applies a combination of cultural, biological and chemical control methods. These are; **Cultural Control** • Synchronize early planting so that the insect does not find and infect young plants to build up its population • Remove all alternate hosts (grass family) and wild rice from the field and field boundaries • Handpick and destroy egg masses • Ploughing after harvest may expose pupae to birds and predators and to the sun. **Biological management** • Spray with *Bacillus thuringiensis* 16000 IU/mg WP at 700 g ai/ha. This spray is recommended only for the control of young (2nd instar) caterpillars because it has a slow action. **Chemical management** • Seed treatment with Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml /kg seed for protection during seedling stage • Spray with Spinetoram 11.7% SC @ 0.5 ml/l or Chlorantraniliprole 18.5 SC @0.4 ml/l or Thiamethoxam 12.6 % + Lambda Cyhalothrin 9.5 % ZC @0.25 ml/l
Justification	Red Teff worm is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 60% have been experienced. Integrated management of Red Teff worm is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally free from pesticide related health risks to Teff farmers and consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On farm demonstrations • Training workshops, Seminars, Meetings • Field days

	• Agricultural shows • MoA/Extension officers • Farmer to farmer • Mass media – Agricultural programmes. • Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM practices. • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain

Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in Red Teff worm management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 6,000
Estimated returns	Approximately Ksh 35,555. If IPM of Red Teff worm is not applied the yield will be reduced by 60%. Therefore, the estimated returns will be 35,555-35, 21,333= **Ksh 14,222**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of red teff worm due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of red teff worm because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of red teff worm • IPM of red teff worm is cheap and reduces production costs therefore user friendly to poor women

	• Where IPM of red teff worm will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of red teff worm protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of red teff worm will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of red teff worm will also lead to increased food security and nutrition for households • IPM of red teff worm adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of red teff worm is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of red teff worm • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of red teff worm will lead to improved productivity of pigeon pea hence more income for VMGs • IPM of red teff worm adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of red teff worm is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press.

F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Capacity building on insect identification and management
2. Validation of bio-pesticides and synthetic pesticides in the management of Teff insects
3. Determine the effects of major pests on Teff yield, quality and implication on economic returns for the farmer

2.7.1.6. TIMP Name	**Integrated management of Desert locust (*Schistocerca gregaria*) of Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Desert feeding on Teff causes vegetative losses of 100 % and reduced quality of the crop.

	  Desert locust (*Schistocerca gregaria*) (Source: theeastafrican.co.ke)
What is it? (TIMP description)	Integrated management of Desert locust applies cultural, biological and chemical control practices against the disease. **Cultural Practices** • A global early warning system of preventive and control of DL is in place. Kenya is a member of Desert Locust Control Organization of Eastern and Central Africa(DLCO-EA). • DLCO-EA uses remote sensing technology and ground surveys to identify and control desert locusts (DL) in their breeding sites. It uses satellite imagery for the identification of potential breeding sites and locust infestations. • Scouting and control of DL in recession (traditional breeding) regions will prevent infestation in invasion (non-traditional) regions **Biological management** • Spray hopper bands using *Metarhizium anisopliae* based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real Metarhizium OD (rate 200ml/ ha) among others. Spray at intervals of 3 - 14 days depending on risk of pest damage **Chemical management** • Spray with cypermethrin based products e.g Ripcord %%EC and Diflubenzuron based products e.g Dimilin OF 6 according to manufacturers' recommendations
Justification	Desert Locust is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 100% have been experienced. Integrated management of desert Locust is an effective management package

	against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Watermelon farmers and consumers. Desert Locust cause considerable reduction in vegetation and lower Teff quality. The use of Integrated Pest Management practices reduces the total cost of production, limits exposure of farmers and consumers to pesticide related health risks, conserves biodiversity and increases yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's

Approaches to be used in dissemination	• On farm demonstrations
	• Training workshops, Seminars, Meetings
	• Field days
	• ASK show
	• Agricultural shows
	• MoA/Extension officers
	• Farmer to farmer
	• Mass media – Agricultural programmes.
	• Promotional materials (posters/brochures/leaflets, manuals)
	  • Web material's
	  • Digital platforms
	  • Farmer Field and Business Schools (FFBS)
	  • Agricultural innovation platforms
	  • Print media brochures
	  • Conferences and journals

Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology

	• KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in Desert Locust management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices

	• Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 8,000
Estimated returns	Approximately Ksh 35,555. If IPM of Desert locust is not applied the yield will be reduced by 100%. Therefore, the estimated returns will be 35,555-35, 35,555= **Ksh 0**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of dessert locust due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of dessert locust because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of dessert locust • IPM of dessert locust is cheap and reduces production costs therefore user friendly to poor women • Where IPM of dessert locust will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of dessert locust protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of dessert locust will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of dessert locust will also lead to increased food security and nutrition for households • IPM of dessert locust adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of desert locust is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of dessert locust

	• VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of dessert locust will lead to improved productivity of pigeon pea hence more income for VMGs • IPM of dessert locust adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of desert locust is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**Reference:** National Institute of Plant Health Management. (2014). AESA based IPM package–pearl millet.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo

Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Capacity building on insect identification and management.

2.7.1.7. TIMP Name	**Integrated management of Welo Bush cricket in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 40% due to crop damage by the pest.  Welo Bush crickef damaging Teff leaves (Source: adriancolston.wordpress.com)
What is it? (TIMP description)	Integrated management of Welo Bush cricket applies cultural, and chemical control practices against the pest. **Cultural Practices** • Slashing of weeds in the field margins before teff has headed to eliminate early instars. • Early sowing • Establish border row with repellent or trap crops. • Erect trap nets to capture the bush crickets. • Scouting and control of Welo Bush cricket in recession (traditional breeding) regions will prevent infestation in invasion (non-traditional) regions **Biological management** • Spray hopper bands using *Metarhizium anisopliae* based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real metarhizium OD (rate 200ml/ ha) among

	others. Spray at intervals of 3 - 14 days depending on risk of pest damage **Chemical management** • Spray with cypermethrin based products e.g Ripcord %%EC and Diflubenzuron based products e.g Dimilin OF 6 according to manufacturers' recommendations
Justification	Welo Bush cricket is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 40% have been experienced. Integrated management of Welo Bush cricket is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Watermelon farmers and consumers. Integrated Pest Management practices reduce the total cost of production, limits exposure of farmers and consumers to pesticide related health risks, conserves biodiversity and increases yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On farm demonstrations • Training workshops, Seminars, Meetings • Field days • ASK show • Agricultural shows • MoA/Extension officers • Farmer to farmer • Mass media – Agricultural programmes. • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects

	• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in Welo Bush cricket management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform

	• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 5,250
Estimated returns	Approximately Ksh 35,555. If IPM of Welo Bush cricket is not applied the yield will be reduced by 40%. Therefore, the estimated returns will be 35,555-35, 14,222= **Ksh 21,333**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of welo bush cricket due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of welo bush cricket because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of welo bush cricket • IPM of welo bush cricket is cheap and reduces production costs therefore user friendly to poor women • Where IPM of welo bush cricket will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of welo bush cricket protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of welo bush cricket will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of welo bush cricket will also lead to increased food security and nutrition for households • IPM of welo bush cricket adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain

	• There will also a reduction of cost of production for women if IPM of welo bush cricket is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of welo bush cricket • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of welo bush cricket will lead to improved productivity of pigeon pea hence more income for VMGs • IPM adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of welo bush cricket is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**Reference:** National Institute of Plant Health Management. (2014). AESA based IPM package–pearl millet.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director

	Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

2.7.1.8. TIMP Name	**Integrated management of termites in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 100% due to crop damage by termites.  Termites (Source: ww3.rics.org)
What is it? (TIMP description)	Integrated management of Termite applies cultural, and chemical control practices against the pest. **Cultural Practices** • Flooding mounds • Queen removal **Chemical management** • Mound-poisoning with relatively safe but effective WHO Class III registered termiticides such as STEWARD 0.3 GR (Granular) according to manufacturer's instructions

Justification	Termite is one of the major pests affecting Pigeon pea production in Kenya. Losses of up to 100% have been experienced. Integrated management of Termite is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of Integrated Pest Management practices reduces the total cost of production, limits exposure of farmers and consumers to pesticide related health risks, conserves biodiversity and increases yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension Agents (Public and Private), research organizations and universities, as well as CGIAR's
Approaches to be used in dissemination	• On farm demonstrations • Training workshops, Seminars, Meetings • Field days • ASK show • Agricultural shows • MoA/Extension officers • Farmer to farmer • Mass media – Agricultural programmes. • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology

	• KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Sensitization is necessary for people to appreciate the use of IPM in Welo Bush cricket management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices

	• Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,450
Estimated returns	Approximately Ksh 35,555. If IPM of termites is not applied the yield will be reduced by 100%. Therefore, the estimated returns will be 35,555-35, 35,555= **Ksh 0**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IPM of termite due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of termite because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of termite • IPM of termite is cheap and reduces production costs therefore user friendly to poor women • Where IPM of termite will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of termite protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of termite will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of termite will also lead to increased food security and nutrition for households • IPM of termite adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of termite is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of termite

	• VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of termite will lead to improved productivity of pigeon pea hence more income for VMGs • IPM of termite adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of termite is adopted
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**Reference:** National Institute of Plant Health Management. (2014). AESA based IPM package–pearl millet.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

2.7.1.9. TIMP name	Integrated Management of Teff Aphids
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids infestation causes up to 30% yield loss on Teff  Aphids pest; *Aphis* sp (Source: extension.usu.edu)
What is it? (TIMP description)	This is an integrated approach of various control methods suppress the aphids below economic injury levels. **Cultural Control** • Prepare land well and apply 10 kg CAN/acre and 14 kgs/acre DAP to increase plant vigour • Conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grass hoppers and spiders) by planting lantana hedges to act as breeding grounds for predators • Rotate with non-host crops e.g. beans, onion and sunflower to prevent build-up of population. • Avoid alternate host crops such as finger millet. • Remove heavily infested plant parts and destroy by burning • Spray with soapy water solution (mix 1 tablespoon of teepol detergent with 4 lts of water or use strong jet of water to wash off aphids **Biological management** • Apply neem based products (e.g. neem oil 40ml/20lts of water, Achook, Nimbecidine) 2 times/month

	Chemical Control Use only pest control products recommended by Pest Control Products Board (PCPB) such as: • Duduthrin 1.75 EC *(Lambdacyhalothrin 17.5 g/L)* • Spray Atom or Decis at the rate of 10-15mls/20lts of water
Justification	Maize Aphid is one of the major pests affecting Teff production in Kenya. Losses of up to 30% have been experienced. Integrated management of Maize Aphid is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Watermelon farmers and consumers. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers. Adoption of an IPM approach would enhance crop yields, food safety among the consumers and also contributes to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Researchers, Academia, Farmers
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Farmers adopt appropriate agronomic practices have well organized farmer groups and networks e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in pest management • PCPB to promote registration of bio-pesticides for integrated pest management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness.

	• Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting Teff and losses attributed to them • Poor linkages among stakeholders in Teff value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish Teff innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	(pesticide+labour) Ksh 4,350

Estimated returns	Approximately Ksh 35,555. If IPM of Aphids is not applied the yield will be reduced by 30%. Therefore, the estimated returns will be 35,555-10,666.50= **Ksh 24, 888.50**
Gender, issues and concerns in development, dissemination adoption and up scaling	• Women and youth have limited knowledge on IPM of aphid due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used for IPM of aphid because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IPM of aphid • IPM of aphid is cheap and reduces production costs therefore user friendly to poor women • Where IPM of aphid will involve mulching it will add more work to women who are already burdened by their domestic roles • IPM of aphid protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IPM of aphid will lead to improved productivity of pigeon pea hence more income for women • Adoption of IPM of aphid will also lead to increased food security and nutrition for households • IPM of aphid adoption will lead to employment opportunities for women and youth at various nodes of pigeon pea value chain • There will also a reduction of cost of production for women if IPM of aphid is adopted.
VMGs issues and concerns in development, adoption and scaling up.	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IPM of aphid

	• VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of teff pests • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IPM of aphid will lead to improved productivity of pigeon pea hence more income for VMGs • IPM adoption will lead to employment opportunities for VMGs at various nodes of pigeon pea value chain • There will also a reduction of cost of production for VMGs if IPM of aphid is adopted
E. Case studies/ profiles of success stories	
Success stories	This is the first time the information is being rolled out.
Application guidelines for users	Esilaba, A.O.et al. (2021). KCEP-CRAL Teff Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya ISBN: 978-9966-30-037-9 CABI-Plantwise Knowledge Bank
F. Status of TIMP readiness	
1-Ready for up scaling 2-Requires validation 3-Requires further research	Ready for up scaling
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**

Lead Organization and Scientist(s)	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2. Diseases of Teff

2.7.2.1 TIMP name	**Integrated management of Loose smut and Seed smut diseases in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 80% due to infection of Teff by the disease.  **Source:** Ashenafi Gemechu Degete (2021)
What is it? (TIMP description)	Integrated management of Loose smut disease consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural management options**: • Plant early using certified seeds. • Practice crop rotation with non-poaceae for a period of 2-3 seasons.

	• Uproot and destroy severely affected plants, including weeds and volunteer crops by burying them deeply. • Do not walk through your field during wet weather to prevent the spread of the disease from one plant to another. • Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected plants by deeply burying them. **Chemical management options**: • Seed treatment with Raxil Super or carbendazim treatments • Spraying copper based products such as copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50 gm/20 litres water or Isacop 50WP at a rate of 60 g/20 litres of water) once initial symptoms are observed.
Justification	Smut is one of the major diseases affecting Pigeon pea production in Kenya. Losses of up to 80% have been experienced. Integrated management of Smut is an effective management package against the disease. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers. Integrated Disease Management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars and meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Need for farmer involvement helps to upscale the management.

	• Accessibility and cost of the practice by farmers: low-cost agricultural practices of burning the diseased plant heads is readily applicable to farmers.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators • CGIAR • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Limited number of extension staff • Limited Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders. • Farmers may not implement some of the practices e.g. Crop rotation due to small farm sizes and limited economic resources.
Suggestions for addressing the challenges	• Disseminate and promote integrated disease management practices and safe use of pesticides • Establish spray teams/champions • Support extension services • Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms.

Social, environmental, policy and market conditions necessary for development and up scaling	• More than one approach is used in management of the disease. • IDM is environment friendly safer and the chemical component should be used judiciously as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the management practice enhances adoption
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of loose smut is not applied the yield will be reduced by 80%. Therefore, the estimated returns will be 35,555-28,444= **Ksh 7,111**
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM of loose smut due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of loose smut because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of loose smut • IDM of loose smut is cheap and reduces production costs therefore user friendly to poor women • Where IDM of loose smut will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of loose smut protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of loose smut will lead to improved productivity of Teff hence more income for women • Adoption of IDM of loose smut will also lead to increased food security and nutrition for households

	• IDM adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM is adopted.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of loose smut will lead to improved productivity of Teff hence more income for VMGs • IDM adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of loose smut is adopted..
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. • Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. • Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	

Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Explore Bio-control options for the diseases
2. Explore the use of ITK's in disease management

2.7.2.2 TIMP name	**Integrated management of Sooty mold disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 60 % due to crop infestation by the diseases

	 {(Source: Ashenafi Gemechu Degete (2021)}
What is it? (TIMP description)	Integrated management of Sooty mold consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural management options**: • Control sucking insects that secrete honeydew such as aphids. • Check new succulent growth for sucking insects like aphids, or any of the other insects. • Fertilize and water properly to keep plants healthy. • Remove the infested plant parts. • Control ants that feed on honeydew and protect sucking insects from predators. • Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected plants by deeply burying them. **Chemical management options**: • Spraying copper based products such as copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50 gm/20 litres water or Isacop 50WP at a rate of 60 g/20 litres of water) once initial symptoms are observed.
Justification	Sooty mold disease coats the leaves thus reducing leaf surface area exposed to sunlight for photosynthesis. Limited sunlight access reduces photosynthesis hence stunts growth. Sooty mould is one of the major pests affecting Pigeon pea production. Losses of up to 70% have been experienced. Integrated management of Smut is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars and meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Need for farmer involvement helps to upscale the management. • Accessibility and cost of the practice by farmers: low-cost agricultural practices of burning the diseased plant heads is readily applicable to farmers.
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of Extension agents • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders

	• Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources. • Farmers may not implement some of the practices e.g. the burying of the diseased plant heads.
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Dissemination of integrated disease management practices and safe use of pesticides in Teff production • Dissemination of agronomic practices • Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	• Establish Teff innovation platforms • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Adoption of good agricultural practices by the producers is key in management of the diseases
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality. • Farmer's willingness to adopt these disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
	Approximately Ksh 35,555. If IDM of sooty mold is not applied the yield will be reduced by 60%. Therefore, the estimated returns will be 35,555-21,333= **Ksh 14,222**

Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited knowledge on IDM of sooty mold due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of sooty mold because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of sooty mold • IDM is cheap and reduces production costs therefore user friendly to poor women • Where IDM of sooty mold will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of sooty mold protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• Opportunities for youth employment in implementing IDM of sooty mold protocols are possible with little technical knowledge for various aerations.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of sooty mold • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of sooty mold will lead to improved productivity of Teff hence more income for VMGs • IDM adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of sooty mold is adopted.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	**References:** 1. Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. 2. Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. 3. Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. 4. Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO

	Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2.3. TIMP Name	**Integrated management of seedling blight (*Pythium, Rhizoctonia, Fusarium, Aspergillus)* disease in Teff.** Seedlings die back due to blight infection
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low Teff yields of up to 60% due to infection by the disease  ***Source:*** Miriam Otipa KALRO
What is it? (TIMP description)	Integrated management of seedling blight consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural management options**: • Plant early using certified seeds. • Use quality certified seeds. • Remove and destroy infected seedlings by burning, • Practice crop rotation with non-poaceae crops for a period of 2-3 seasons. • Ensure that field sanitation and hygiene practices are adhered to by collecting and safely disposing infected plants by deeply burying them. **Chemical control options**: • Dressed seeds with Amigo GT, Dividend 030

	FS, or Raxil Super 375 at recommended rates • Drench using carbendazim based products e.g. Rodazim or Mancozeb based products
Justification	Seedling blight is one of the major disease affecting Pigeon pea production in Kenya. Losses of up to 60% have been experienced. Integrated management of Seedling blight is an effective management package against the pest. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers. Besides, Integrated Disease Management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia.
Approaches to be used in dissemination	• On farm demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer to farmer • Mass media – Agricultural programs. • Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• Strong partnership linkages • Carry out Applied and adaptive research to validate and release improved Teff varieties • Create a platform for interaction of Teff value chain stakeholders • Farmers adopt appropriate agronomic practices. • Form well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of fungicides for disease management • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators. • Extension service providers (public and private) to help in the dissemination. • CGIARs

	• NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management practices • Few farmer groups • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders.
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Dissemination of integrated disease management practices and safe use of pesticides
Lessons learned in up scaling if any	• Adoption of good agricultural practices by the producers is key in management of the disease. • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in dissemination and adoption of the management practice and this can be facilitated through innovation platforms. • More than one approach is used in management of major diseases. • IDM is environment friendly and the chemical option should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption.
Social, environmental, policy and market conditions necessary for development and up scaling	• Adoption of good agricultural practices by the producers is key in management of the disease. • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in dissemination and adoption of the management practice and this can be facilitated through innovation platforms. • More than one approach is used in management of major diseases. • IDM is environment friendly and the chemical option should be used as the last resort

	• Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of seedling blight is not applied the yield will be reduced by 60%. Therefore, the estimated returns will be 35,555-21,333= **Ksh 14,222**
Gender issues and concerns in development , dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of seedling blight due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of seedling blight because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of seedling blight • IDM of seedling blight is cheap and reduces production costs therefore user friendly to poor women • Where IDM of seedling blight will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of seedling blight protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of seedling blight will lead to improved productivity of Teff hence more income for women • Adoption of IDM of seedling blight will also lead to increased food security and nutrition for households • IDM of seedling blight adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of seedling blight is adopted.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of seedling blight • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of seedling blight will lead to improved productivity of Teff hence more income for VMGs • IDM adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of seedling blight is adopted.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	References: • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. • Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. • Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit.

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Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2.4 TIMP Name	**Integrated management of Leaf blight disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice  Long elliptical reddish lesions on older leaves **Source:** KALRO
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 30%
What is it? (TIMP description)	Integrated disease management for Leaf blight comprises of the use of cultural and chemical management practices against the disease in Teff. **Cultural practices**: • Destroy crop residues and volunteer plants after harvest in the farm

	• practicecrop rotation. • Practice good field sanitation and hygiene practices by collecting and safely disposing infected plants. • Regular weeding **Chemical management**: • Spray affected plants using azoxystobin based products e.g. ortiva at 20 ml/20 litres of water or copper based fungicide at 40 g/20 litres of water
Justification	Leaf blight is one of the major diseases affecting Pigeon pea production. Losses of up to 30% have been experienced. Integrated management of Leaf blight is an effective management package against the disease. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Watermelon farmers and consumers.
Region to be promoted	All counties growing Teff
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination

	• CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases
Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of leaf blight is not applied the yield will be reduced by 30%. Therefore, the estimated returns will be 35,555-10,666.50= **Ksh 24,888.50**

Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of leaf blight due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of leaf blight because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of leaf blight • IDM is cheap and reduces production costs therefore user friendly to poor women • Where IDM of leaf blight will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of leaf blight protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of leaf blight will lead to improved productivity of Teff hence more income for women • Adoption of IDM of leaf blight will also lead to increased food security and nutrition for households • IDM of leaf blight adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of leaf blight is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of leaf blight

	• VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM will lead to improved productivity of Teff hence more income for VMGs • IDM of leaf blight adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of leaf blight is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). Pest and disease management handbook. John Wiley & Sons. • Briggs, S. (2008). Organic cereal and pulse production: a complete guide. Crowood Press. • Wallwork, H. (2000). Cereal root and crown diseases. Grains Research and Development Corporation. • Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). Diseases of small grain cereal crops: a colour handbook. CRC Press.
F: **STATUS OF TIMP READINESS** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Centre Director, KALRO-Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO Rachael Kisilu, Daniel Mutisya, Sila Nzioki, Harun Odhiambo, Ruth Amata and Mercyline Orayo
Partner organizations	MoALF, ICRAF, CABI

Research Gaps

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

2.7.2.5 TIMP Name	**Integrated management of Leaf Blast disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 40% due to infection of Teff by the disease  Blast disease on Teff leaves (Source: Ashenafi Gemechu Degete (2021)
What is it? (TIMP description)	Integrated disease management for Leaf blast uses cultural management practices and chemical control in the management of the disease in Teff. **Cultural practices**: • Destroy crop residues and volunteer plants after harvest in the farm • Practice crop protection • Practice good field sanitation and hygiene practices by collecting and safely disposing infected plants. • Regular weeding **Chemical management**: • Spray affected plants using azoxystobin based products e.g. ortiva at 20 ml/20 litres of water or copper based fungicide at 40 g/20 litres of water.

Justification	Leaf blast is one of the major diseases affecting Pigeon pea production in Kenya. Losses of up to 40% have been experienced. Integrated management of Leaf blast is an effective management package against the disease. It involves the integration of various options including cultural, physical, biological and chemical options.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Universities, Processors, Traders
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations

	• Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides.
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases.
Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of leaf blast disease is not applied the yield will be reduced by 40%. Therefore, the estimated returns will be 35,555-14,222= **Ksh 21,333**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of leaf blast disease due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of leaf blast disease because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married

	• Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of leaf blast disease • IDM of leaf blast disease is cheap and reduces production costs therefore user friendly to poor women • Where IDM of leaf blast disease will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of leaf blast disease protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of leaf blast disease will lead to improved productivity of Teff hence more income for women • Adoption of IDM of leaf blast disease will also lead to increased food security and nutrition for households • IDM of leaf blast disease adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of leaf blast disease is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of leaf blast disease • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of leaf blast disease will lead to improved productivity of Teff hence more income for VMGs • IDM of leaf blast disease adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of leaf blast disease is adopted.

E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. • Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. • Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: **STATUS OF TIMP READINESS** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
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Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Explore Bio-control options for the disease

2. Explore the use of ITKs in disease management at different stages of the disease

2.7.2.6 TIMP Name	**Integrated management of Leaf Rust disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 40% due to infection of Teff by the disease  Leaf rust symptom on mature Teff leaves (Source: Ashenafi Gemechu Degete (2021)
What is it? (TIMP description)	Integrated management of common leaf rust consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural management options**: • Plant early. • Observe field sanitation-remove and bury infected crop debris. • Remove weeds which may act as alternative hosts. • Avoid overhead irrigation-increases humidity on the leaves. • Sterilize tools with 50ml Jik per litre of water. • Limit movement from infected to clean field. **Use of Early Maturing Varieties** • Use of early maturing varieties such as Marsabit 2-1 (TMSB2-1) and Aila Red 2(TAR 2) **Chemical control options**:

	• Apply AG COPP 75WP,AMICOP 50WP or Eazole 250EC or Abacus Advance 125 SE at the rate recommended by the manufacturer.
Justification	Leaf Rust is one of the major diseases affecting Pigeon pea production. Losses of up to 40% have been experienced. Integrated management of Leaf Rust is an effective management package against the disease. It involves the integration of various options including cultural, physical, biological and chemical options.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production

Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in dissemination and adoption of the management practice through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases
Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of leaf rust is not applied the yield will be reduced by 40%. Therefore, the estimated returns will be 35,555-14,222= **Ksh 21,333**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of leaf rust due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of leaf rust because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married

	• Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of leaf rust • IDM of leaf rust is cheap and reduces production costs therefore user friendly to poor women • Where IDM of leaf rust will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of leaf rust protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of leaf rust will lead to improved productivity of Teff hence more income for women • Adoption of IDM of leaf rust will also lead to increased food security and nutrition for households • IDM of leaf rust adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of leaf rust is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of leaf rust • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of leaf rust will lead to improved productivity of Teff hence more income for VMGs • IDM of leaf rust adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of leaf rust is adopted.

E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. • Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. • Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: **Status of TIMP Readiness** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

1. Explore Bio-control options for the disease

2. Explore the use of ITKs in disease management at different stages of the disease

2.7.2.7 TIMP Name	**Integrated management of Zonate eye spot disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 40% due to infection of Teff by the disease  Zonate Eye Spot caused by H. giganteum Source: Ashenafi Gemechu Degete (2021)
What is it? (TIMP description)	Integrated disease management for Zonate eye spot comprises of the use of cultural management practices, deployment of tolerant varieties and chemical control in the management of the disease in Teff. **Cultural practices**: • Observe field sanitation-remove and bury infected crop debris. • Remove weeds which may act as alternative hosts. • Avoid overhead irrigation-increases humidity on the leaves. • Sterilize tools with 50ml Jik per litre of water and limit movement from infected to clean field. **Chemical management**: • Apply Propiconazole 25 EC and Triadimefon 25 EC/WP based products e.g Bumper 25EC and Bayleton WP respectively according to manufacturers' recommendation.
Justification	Zonate eye spot is one of the major diseases affecting Pigeon pea production. Losses of up to 40% have been experienced. Integrated management of Zonate eye spot is an effective management package against the disease. It involves the

	integration of various options including cultural, physical, biological and chemical options.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms

	• Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases
Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of zonate eye spot is not applied the yield will be reduced by 40%. Therefore, the estimated returns will be 35,555-14,222= **Ksh 21,333**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of zonate eye spot due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of zonate eye spot because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of zonate eye spot • IDM of zonate eye spot is cheap and reduces production costs therefore user friendly to poor women

	• Where IDM of zonate eye spot will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of zonate eye spot protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender
Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of zonate eye spot will lead to improved productivity of Teff hence more income for women • Adoption of IDM of zonate eye spot will also lead to increased food security and nutrition for households • IDM of zonate eye spot adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of zonate eye spot is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of zonate eye spot • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of zonate eye spot will lead to improved productivity of Teff hence more income for VMGs • IDM of zonate eye spot adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of zonate eye spot is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** 1. Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons.

	2. Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. 3. Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation. 4. Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: **Status of TIMP Readiness** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2.8 TIMP Name	**Integrated management of Head Smudge in Teff**

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 80% due to infection of Teff by the disease  Head smudge symptom on mature teff heads **Source:** Ashenafi Gemechu Degete (2021)
What is it? (TIMP description)	Integrated management of Head Smudge uses various approaches in management of the disease. They include: cultural management, and chemical control. **Cultural practices**: • Plant disease-free seeds. • Plough Teff debris into the soil after harvesting • Practice crop rotation. • Remove weeds which may act as alternative hosts. • Limit movement from infected to clean field. • Treat seeds with thiram or captan based products at 3 g/ 3kg before planting **Chemical management**: • Spraying copper based products such as copper oxychloride (cuprocaffaro micro 37.5 at a rate of 50 gm/20 litres water or Isacop 50WP at a rate of 60 g/20 litres of water) once initial symptoms are observed.
Justification	Head Smudge causes up to 80% grains losses and reduces market quality of Teff in Kenya. Losses occasioned by the diseases lead to reduced returns for the farmers and negatively impacts on food and national security of the country.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings

	• Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases

Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of head smudge is not applied the yield will be reduced by 80%. Therefore, the estimated returns will be 35,555-28,444= **Ksh 7,111**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of head smudge due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of head smudge because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of head smudge • IDM of head smudge is cheap and reduces production costs therefore user friendly to poor women • Where IDM of head smudge will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender

Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of head smudge will lead to improved productivity of Teff hence more income for women • Adoption of IDM of head smudge will also lead to increased food security and nutrition for households • IDM of head smudge adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of head smudge is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of head smudge • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of head smudge will lead to improved productivity of Teff hence more income for VMGs • IDM of head smudge adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of head smudge is adopted..
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** 1. Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. 2. Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. 3. Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation.

	4. Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press.
F: **Status of TIMP Readiness** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2.9 TIMP Name	**Integrated management of Leaf spot disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem to be addressed	Yield loss of between 10-20% per annum due to infection of Teff by the disease  Source: mdpi.com
What is it? (TIMP description)	Integrated management of Leaf spot uses various approaches in management of the diseases. They include: cultural management, and chemical control. **Cultural practices**: • Use certified seeds • Soak seeds in 2% saline solution that will help float Leaf spot infested seeds before planting. • Practice crop rotation with non-legumes. • Work in uninfected parts of the field first before the infected area. • Avoid unnecessary movement in infected areas to minimize spread of the disease, disinfect farm implements after working from one field before proceeding to the other. • Treat seeds with thiram or captan based products at 3 g/ 3kg before planting. **Chemical management**: • Spray Mancozeb based products (Oshothane or Farmcozeb at 2kg/ha or Carbendazim products according to manufacturers' recommendation
Justification	Teff Leaf spot disease causes 10-20% grains losses and reduces market quality of Teff. Losses occasioned by the diseases lead to reduced returns for the farmers and negatively impacts on food and national security of the country.
Region to be promoted	All counties growing Teff
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings

	• Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be upscaled	Marsabit and any other county with suitable agro-ecological settings for Teff production
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases

Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of leaf spot is not applied the yield will be reduced by 20%. Therefore, the estimated returns will be 35,555-7,111= **Ksh 28,444**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of leaf spot due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of leaf spot because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of leaf spot • IDM of leaf spot is cheap and reduces production costs therefore user friendly to poor women • Where IDM of leaf spot will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of leaf spot protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender

Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of leaf spot will lead to improved productivity of Teff hence more income for women • Adoption of IDM of leaf spot will also lead to increased food security and nutrition for households • IDM of leaf spot adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of leaf spot is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM of leaf spot will lead to improved productivity of Teff hence more income for VMGs • IDM adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of leaf spot is adopted.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**Reference:** • Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. • Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press. • Wallwork, H. (2000). *Cereal root and crown diseases*. Grains Research and Development Corporation.

	• Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press. • Ashenafi Gemechu Degete, "Major Tef Diseases in Ehtiopia and their Management" International Journal of Research Studies in Agricultural Sciences (IJRSAS), 2021; 7(2), pp. 31-37, https://doi.org/10.20431/2454-6224.0702005
F: **Status of TIMP Readiness** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.2.10 TIMP Name	**Integrated management of Damping off disease in Teff**
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield loss of up to 50% per due to infection of Teff seedlings by the disease  Source: gardenerspath.com
What is it? (TIMP description)	Integrated management of Leaf spot disease encompasses the use of various approaches in management of the diseases. They include: cultural, biological and chemical practices. **Cultural practices**: • Use disease free seeds • Providing good drainage (raised beds, properly graded fields). • Plant when soil and air temperatures are favorable for rapid seedling emergence. **Biological** • Apply *Trichoderma* spp. and *Gliocladium* spp. or bacteria such as *Pseudomonas* spp. and *Bacillus* spp. at recommended rates. **Chemical management**: • Apply etridiazole and metalaxyl; benomyl, mancozeb, maneb, and thiophanate methyl based fungicides at recommended rates against Fusarium wilt pathogens
Justification	Damping off is one of the major diseases affecting Pigeon pea seedlings. Losses of up to 50% have been experienced. Integrated management of Damping off is an effective management package against the disease. It involves the integration of various options including cultural, physical, biological and chemical options. The use of integrated approach is environmentally beneficial and generally risk-free for Teff farmers and consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	• On farm and on station research trails and demonstrations • Training workshops, seminars, meetings

	• Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web materials • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms
Critical/essential factors for successful promotion	• Strong partnership linkages • Farmer involvement will be necessary for successful implementation of the IDM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments-Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit and any other county with suitable agro-ecological settings for Teff production.
Challenges in dissemination	• Limited knowledge by farmers on integrated disease management • Few farmer group organizations • Lack of Teff innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Teff innovation platforms • Hold mass campaigns to create awareness on integrated disease management practices and safe use of pesticides
Lessons learned in upscaling, if any	• Establish Teff innovation platforms • Foster more Partnership in technology dissemination and adoption through innovation platforms. • Adoption of good agricultural practices by the farmers in management of diseases

Social, environmental, policy and market conditions necessary for development and upscaling.	• Regulatory bodies e.g. PCPBP, KBS to ensure pesticides being used by farmers are genuine and are of high quality • Farmer's willingness to adopt the disease management practices • Farmers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers. • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grains
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(pesticide+labour) Ksh 3,500
Estimated returns	Approximately Ksh 35,555. If IDM of damping off disease is not applied the yield will be reduced by 50%. Therefore, the estimated returns will be 35,555-17,777.50= **Ksh 17,777.50**
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited knowledge on IDM of damping off disease due to lack of access to agricultural information and extension services • Women and youth might not be able purchase the chemical used to for IDM of damping off disease because they do not have finances due to limited access to credit facilities • Most of the decisions relating to the crop health and control are done by men as the head of the households for those who are married • Most of the women are semi-illiterate and they might not have adequate skills so they might not understand the protocols written on IDM of damping off disease • IDM of damping off disease is cheap and reduces production costs therefore user friendly to poor women • Where IDM of damping off disease will involve mulching it will add more work to women who are already burdened by their domestic roles • IDM of damping off disease protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender

Gender related opportunities	• There will be creation of job opportunities for the youth in setting traps and marketing pest traps • Adoption of IDM of damping off disease will lead to improved productivity of Teff hence more income for women • Adoption of IDM of damping off disease will also lead to increased food security and nutrition for households • IDM of damping off disease adoption will lead to employment opportunities for women and youth at various nodes of Teff value chain • There will also a reduction of cost of production for women if IDM of damping off disease is adopted.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality seeds • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to agricultural information and extension so they might not be aware of IDM of damping off disease • VMGs lack finances due to limited access to credit facilities they might not be able to purchase some of the chemicals used for control of Teff diseases • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• The technology can improve food and nutrition security for VMGs • Adoption of IDM will lead to improved productivity of Teff hence more income for VMGs • IDM adoption will lead to employment opportunities for VMGs at various nodes of Teff value chain • There will also a reduction of cost of production for VMGs if IDM of damping off disease is adopted.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	**References:** 1. Alford, D. V. (Ed.). (2008). *Pest and disease management handbook*. John Wiley & Sons. 2. Briggs, S. (2008). *Organic cereal and pulse production: a complete guide*. Crowood Press.

	3. Murray, T. D., Parry, D. W., & Cattlin, N. D. (2013). *Diseases of small grain cereal crops: a colour handbook*. CRC Press. 4. Ashenafi Gemechu Degete, "Major Tef Diseases in Ehtiopia and their Management" International Journal of Research Studies in Agricultural Sciences (IJRSAS), 2021; 7(2), pp. 31-37, https://doi.org/10.20431/2454-6224.0702005
F: **Status of TIMP Readiness** (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Institute Director Sheep, Goat and Camel Research Institute KALRO-Marsabit P.O. Box 147 (60500) Marsabit. Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	KALRO Yussuf Aila, Racheal Kisulu, Ruth Amata, Harun Odhiambo and Mercyline Orayo
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

Research Gaps

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

2.7.3. Weed Management

2.7.3.1 TIMP Name	**Integrated Weed Management for Teff**

Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Weed competition reducing yields and hence lack of returns. Limited labour to control the big biodiversity of weeds that pose a problem including yellow fox tail (*Sateria pumila*), Love grass (*Setaria verticillata*) among others.
	Source: Hottensiah Mwangi
	
	Goose grass or Wild finger millet (*Eleusine indica* (L.) Gaertn.) Source: Hottensiah Mwangi
	
	Double thorn (*Oxygonum sinuatum* (Meisn.) Dammer among other weeds such as crows foot (*dactyloctenium aegyptium*) Source: Hottensiah Mwangi
	
	Gallant soldier (*Galinsoga parviflora Cav.*) Source: Hottensiah Mwangi

	 Blackjack (*Bidens pilosa* L.) and Wild lettuce (*Launaea cornuta* (Oliv.&Hiern)) Source: Hottensiah Mwangi
What is it? (TIMP description)	Integrated Weed Management (IWM) is the management of weeds using two or more approaches including preventive, land preparation and tillage (Physical), use of biodegradable or synthetic mulch, cultural, use of competitive Teff varieties to suppress weeds and use of Allelopathic effect of Teff. The choice of any two or more methods depends on the weed infestation. Mulch can be applied to cover the space (20cm) between Teff rows. Physical control is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks). Teff is early maturing (45 to 120 days), low yielding (yields 900kg to 2800kg/ha) depending on environment, Resistant and tolerant to all pest and diseases, and is drought tolerant. Its characteristic features include: cream white, white, brown and red grain colour. Optimal environmental condition: Temperature above 28^{o}C; optimal is 32^{o}C (65F) but can tolerate temperatures up to 35^{o}C; Rainfall between 400mm – 600mm annually; optimum altitude – 1,800 to 2,100 m but can grow 3,000 m (0 – 1500). Soil type – low desert sand to waterlogged clay.
Justification	Weeds germinate early and grow in close association with teff competiting for the limited nutrients, moisture, and space. Communities have been growing Teff in Kenya since 1962. The crop is highly adopted in northern Kenya. It is early maturing as demanded by farmers, high yielding, synchronous in maturity allowing one time harvesting, produces palatable and nutritious food products. Because of early maturity, it is drought escaping and thus assuring climate resilient produce.

	As a cereal, it provides food diversity and security. Hence weeds should be managed using the best integrated weed management approaches timely to minimize any yield loss due to weeds.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension agencies, processing industry, seed producers and traders
Approaches to be used in dissemination	• ToTs, Extension publications (leaflets, booklets, posters etc.) • Farmer Field Business Schools • Local FM Radio Stations • Farmer group training • On-farm experimentation • Field days • Agricultural shows and trade fairs • Farmer to farmer communication • Plot demonstrations, small seed packets • Agricultural Innovation platforms • Digital platforms and agricultural shows
Critical/essential factors for successful promotion	• Participatory Implementation, • Stakeholder capacity building, • Stakeholder networks, • Effective extension services
Partners/stakeholders for scaling up and their respective roles	• Extension-promotion, • private service providers provision of seeds • KALRO-Provision of seeds and Capacity building. • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for teff • Farmers: Test/validate and produce • CGIARS e.g: Donors: Funding and technical backstopping
C: Current situation and future scaling up	• Lack of certified seeds has slowed down commercialization of this crop. • Limited knowledge on Teff integrated weed management is limiting production. • IWM requires validation.
Counties where already promoted, if any	Marsabit
Counties where TIMPs will be up-scaled	Marsabit, Kitui, Makueni, Tharaka Nithi, Mandera, Wajir, Isiolo

Challenges in dissemination	• Low publicity • Lack of support from national government • Limited research inputs • Limited knowledge on weed biology where a biodiversity of weed species give competition to Teff • Limited knowledge on Integrated weed management to reduce teff yield loss and returns.
Suggestion for addressing the challenges	• Enhanced publicity • Increased extension services • Increased research activities on integrated weed management, • Develop capacity of stakeholders on biology of weeds affecting Teff cropping systems, • Evaluate Teff competitive varieties that can tolerate weeds. • Use knowledge on Allellopathic effects on weeds.
Lessons learned In upscaling	• An Investments in the crop and participation of champions can enhance technology up-take – like the case of this technology in northern Kenya stakeholder linkages and participatory implementation is important. • Weeds occurring in different environments producing Teff and their competitive abilities have not been established • Successful teff variety promotion requires availability of ready and consistent market for anticipated increased production.
Social, environmental, policy and market conditions necessary for development and scaling	• Farmers' willingness: Teff is currently considered globally as a super food. In Marsabit, it is socially acceptable and any technology to increase its production will be readily adopted. • Awareness creation of the benefits/advantages/management of the technology could enhance acceptability and increased up take. • Existence of suitable bio-physical environments in target counties. • Availability of commodity market. • Favourable weather conditions • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000

Estimated returns	Grain seed loss without weed control: 100Kg @110=KES 11,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Weeding is usually done by women and weeding in teff farms is complicated by the method used for planting , that is broadcasting • Teff production is labour intensive and likely to consume a lot of productive hours , this adds the workload of women which is already complicated by the multiple roles they play in the households • Women and youth have limited access to production resources such as land, capital to purchase herbicides • Women have less access to agricultural information and extension so they might not have any knowledge on IWM • Women might be able to able to read and understand the protocols and dissemination material written on IWM due to illiteracy
Gender related opportunities	• There will be creation of jobs for women and youth in agro-vet shops increasing income for them • There will be improved food security and nutrition from for women • There will be increased job security for women and youth by spraying herbicides • Use of IWM technology can reduce labour from manual weeding and save time for other activities for women and children
VMG issues and concerns in development, dissemination, adoption and scaling up;	• Weeding in teff farms is labor intensive for VMGs to undertake • VMG groups could have limitations in accessing TIMP due to limited access to agricultural information and extension • VMGs have no funds and resources to purchase herbicides due to limited access to credit facilities. • VMGs might be able to able to read and understand the protocols and dissemination material written on IWM due to illiteracy
VMG related opportunities	• Can create employment for VMG at various nodes of the value chain • There in potential of increased production of teff which will lead to increased food security and nutrition • There will be increased supply of teff to the markets for VMGs hence increased incomes

E: Case studies/profiles of success stories	
Success stories from previous similar project	• By Americans who have commercialized Teff farming and have developed various product packed in a very appealing packages
Application guidelines for users	Source of seeds, direct planting to the field
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research R	Require validation
G: Contacts	
Contacts	KALRO-Marsabit; Cell: 0723-825-061; Email: ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Hottensiah Mwangi, Yussuf K Aila, Kisilu R. and Lusike Wasilwa
Partner organizations	County government of Marsabit and local NGOS and CBOS

2.7.3.2. TIMP Name	Planting Teff innovatively in rows
Category (i.e. technology, innovation or management practice)	Innovation   Teff planted in rows for ease of weeding Source: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem addressed	Labour intensity in Teff weeding or cultivation leading to yield loss and reduced returns. Hence little available teff for use. (consumption, processing, trade, manufacturing etc)

What is it? (TIMP description)	Planting Teff in rows spaced at 20 x drill inter and intra-row spacing, respectively. Planting is done by making furrows at the specified spacing, then drilling in manure, 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, time consuming labour intensive hand weeding.
Justification	Weeding is one of the most labour intensive operations in Teff cultivation. Planting in rows will make weeding easier and reduce labour and time used for weeding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers and extension agencies
Approaches to be used in dissemination	• On-farm experimentation and dissemination, • field days, shows, • farmer to farmer communication, • leaflets, • larger plot demonstrations.
Most effective approach	• On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	• Participatory Implementation, • Ftakeholder capacity building, • Functioning seed system, • Stakeholder networks and investment in Integrated Weed Management research.
Partners/stakeholders for scaling up	• MoALF&I • NGOs e.g FIPs (Farmer Input Promotion) • CBOs • Farmer Groups • Service provider agencies e.g. micro-finance agencies, banks agro-vets, processors and manufacturers, aggregators
C: Current situation and future scaling up	
Counties where already promoted if any	• This has not been promoted in Kenya and adoption rate is unknown.
Counties where TIMP w be up scaled	• Marsabit , Isiolo, Mandera, Kitui, Makueni and other ASAL Counties
Challenges in dissemination	• Limited investment in crop • limited publicity • low research

Recommendations for addressing the challenges	• Investment in crop development (research and extension • Positive publicity
Lessons learned	• Investments in the crop and participation of champions can enhance technology up-take. Greater demand from other communities living in Marsabit arable farms. • Teff has potential to produce other nutritious food security products.
Social, environmental, policy and market conditions necessary	• Women are main players in Teff cultivation/weeding; and, row planting will ease women labour and capacity building of stakeholders • Understanding the physical and biotic environment in target ecologies • Understanding community culture, preferences, and practices
D**: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	KES 31,000
Estimated returns	Grain seed loss without weed control: 100 Kg @110=KES 11,000
Gender issues and concerns in development, dissemination adoption and scaling up	• Weeding is usually done by women and weeding in teff farms is complicated by the method used for planting , that is broadcasting • Women are main players in Teff cultivation/weeding increasing the workload for women wo are highly burdened by their domestic roles at home • Women might not be aware that planting teff in rows is a way of controlling weed • Women and youth have limited access to production resources such as land, capital to purchase herbicides • Women work is complicated by their multiple roles they do such as such domestic roles
Gender related opportunities	• Employment opportunities for youth as service providers. • Mechanical weeder can be developed to reduce weeding and to reduce the work for women • Planting teff in rows will make it easy to work in the teff farms for women • There would be increased production of teff hence improved food security and nutrition
VMG issues and concerns in development and 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 Teff crop for the VMGs including value addition aspects. • VMG groups could have limitations in accessing the knowledge, resources and exposed as they are have many challenges such as insecurity and land disputes. • VMG have less access to extension training as they are not given equal opportunities • VMG have less access to knowledge and information on IWM • VMG have less access to capital to purchase herbicides • VMG to generate income by starting cortege value addition factories due to enhanced yield • Labour intensity reduction will lead to easier production by VMGs.
VMG related opportunities	• There will be creation of employment for VMGs in marketing teff • Planting teff in rows will make it easy to work in the teff farms for VMGs • There would be increased production of teff hence improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories	• Not yet established
Application guidelines for users	• Brochures are available for reference
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	• Ready for upscaling
G: Contacts	
Contacts	KALRO- Marsabit
Lead organization and scientists	KALRO, Hottensiah Mwangi, Yussuf Aila & Lusike Wasilwa
Partner organizations	ICRISAT Nairobi; MoALF&I in Counties

2.7.3.3. TIMP Name	**Competitive Teff Varieties to control weed**
Category (i.e. technology, innovation or management practice)	Technology

	 Competitive Teff varieties Source: Kisilu R.K
A: Description of the technology, innovation or management practice	
Problem addressed	Tedious and difficult weeding labour required in traditionally, broadcasted Teff seed using a high seed rate of between 25 to 30 kg per hectare. This practice reduces yield because the uneven distribution of seed increases competition between Teff plants and also weeds for water, light, and nutrients
What is it? (TIMP)	Use of suitable competitive Teff varieties at reduced seed rates and planting in rows. Reducing the seed rate to 5-10 kg per hectare reduces competition between seedlings and allows for optimal tillering or branching out of the plants. By planting in rows, weeding can be done more easily and faster. Planting competitive varieties in rows reduces incidence of lodging as the stem of row planted Teff is better able to support the weight of the filled head of grain. Competitive varieties will tolerate and suppress weeds.
Justification	Uncompetitive Teff varieties planted at high seed rates compete amongst themselves and with weeds for nutrients, moisture, space and sunlight. The potential of competitive Teff and reduced seed rate technologies will reduce problem of lodging and weak stems that cannot support the weight of filled head of grain. Reduced seed rate reduces competition among teff and weeds for limited water resources, light and nutrients and enhance productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Agro-pastoralists in the arable pockets of northern Kenya.(mountain oasis and riverine)
Approaches to be used in dissemination	• Demonstrations, farmers field schools and exhibition exchange educational tour

Critical/essential factors for successful promotion	• Combinations of two or more methods of weed management will improve potential yield of Teff. • High diversity of competitive varieties at development stages morphologically, physiologically and phenological traits enable Teff to adopt to various mixture of conditions therefore it can perform under drought and flood conditions.
Partners/stakeholders for scaling up	• County department of Agriculture-funding • NGOS CBOS –promotion. • Donors- Funding
C: Current situation and future scaling up	
Counties where already promoted if any	• This has not been promoted in Kenya and adoption rate is unknown.
Counties where TIMP w be up scaled	• Marsabit , Isiolo, Mandera, Kitui, Makueni and other ASAL Counties
Challenges in dissemination	• Limited knowledge on the Teff weed management practices • Limited support from national government county government • Limited good national policy on special climate smart crops like Teff.
Recommendations for addressing the challenges	• Validation of Integrated weed management using certified competitive Teff varieties of seeds. • National and County Government should invest more on Teff Validation research on farm. • Promote the Teff competitive varieties as climate smart technology.
Lessons learned	• Recommended seed rate of competitive varieties will reduce timeand weeding labour and increase productivity yield in terms of grain and biomass for livestock.
Social, environmental, policy and market conditions necessary	• Producers willing to adopt Teff integrated weed management practices • Producers are organized in groups to ensure that integrated weed management practices are effectively up-scaled • Regulatory bodies e.g., PCPB, KBS to ensure pesticides sold to farmers are genuine and of high quality and safe for humanity and livestock. • Farm input costs are within the reach of farmers. • Capacity building of stakeholders and development of sound

	marketing policy.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000 per acre (certified seeds, land preparation, planting, weeding harvesting and storage)
Estimated returns	Returns: 840 Kg/acre @ KES110 = KES 92,400 Net profit = 61,400
Gender issues and concerns in development, dissemination, adoption and scaling up.	• Weeding is usually done by women and weeding in teff farms is complicated by the method used for planting , that is broadcasting • Broadcasting method of planting teff make it tedious for weeding and harvesting which increases the work of stakeholders in teff production especially women whose work is complicated by their multiple roles in the households • Women and youth have limited access to production resources such as land, capital to purchase herbicides • Women have less access to agricultural information, technology and knowledge on new methods of controlling weed such as the use of competitive Teff Varieties to control weed • Women have limited finances to hire labor to assist in teff farms due to limited access to credit facilities
Gender related opportunities	• The use of competitive Teff Varieties to control weed t will improve the potential of teff yield hence increase food security and nutrition for women and youth • Adoption of the TIMP will enable teff to adopt to various mixtures of conditions drought and floods offering stable food and supply to the market for women
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 Teff technologies to the VMGs all aspects • VMG groups have limited access to product resources such as land, equipment and information • VMGs have limited finances to hire labor and purchase excess seeds due to limited access to credit facilities .

VMG related opportunities	• . The use of competitive Teff Varieties to control weed will improve the potential of teff yield hence increase food security and nutrition for VMGs • Adoption of the TIMP will enable teff to adopt to various mixtures of conditions drought and floods offering stable food and supply to the market for VMGs
E: Case studies/profiles of success stories	
Success stories	No success stories recorded.
Application guidelines for users	Teff brochures, fliers, modules and manuals
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Yussuf k Aila; cellphone no;0723825061 ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Hottensiah Mwangi, Yussuf Aila &Lusike Wasilwa
Partner organizations	MoAL&F in Counties CBOs,NGOs Women groups;

2.7.3.4 TIMP Name ;	**Motorized Weeding**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Limited labour for weeds management lead to significant economic yield loss in Teff cropping system. Weed competition with teff reduces yield leads to low production and utilization (consumption, processing, trade, manufacturing etc.).
What is it? (TIMP description)	Use of machine to Manage weeds and should be done at 2 weeks after planting and just before flowering (about 4-6 weeks). Teff is an early maturing (45 to 120 days) and requires an appropriate motorized weeder for efficient and effective weeding.
Justification	Tiny seeded Teff is sensitive to weeds and therefore needs protection from smothering effect of weeds. Farmers use traditional tool and this tedious, time consuming and labour intensive. Motorized weeding is a new good technology producers to empower teff growers in integrated weed management.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers and extension agencies and other development partners
Approaches used in developments dissemination	• On-farm experimentation and dissemination, • Field days, • Agricultural shows, • Farmer to farmer communication.
Most effective approach	• On-farm experimentation • Larger plot demonstrations. • Exchange tours
Critical/essential factors for successful promotion	• Participatory Implementation, • Stakeholder require capacity building, • Need for a Functioning seed system, • Stakeholder networks
Partners/stakeholders for scaling up	• MoAL&F, -promotion • NGOs, CBOs, Farmer Groups,-upscaling • Service provider agencies. –provision of machines. • KALRO to continually undertake adaptive research to validate integrated weed management using machine. • KEPHIS to ensure seed quality is maintained • PCPB to promote registration of appropriate pest control products for weed management. • Farmers/farmer groups to upscale the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	• This has not been promoted in Kenya and adoption rate is unknown.
Counties where TIMP w be up scaled	• Marsabit , Isiolo, Mandera, Kitui, Makueni and other ASAL Counties
Challenges in dissemination	• Limited information on integrated weed management practices of Teff. • Lack of awareness and limited publicity Limited extension service • Lack of research on efficient implements in managing weeds in Teff cropping systems • Limited information and knowledge on demonstrated facts on effects of integrated weed management in Teff in Kenya using new implements.

Recommendations for addressing the challenges	• Demonstrate effects on integrated weed management in Teff using a machine • Carryout research on response of weeds to Teff and conduct research on competitive varieties to suppress weeds. • Training of farmers on the value of IWM for Teff (at least two approaches); • Increase Investment in crop development (research and extension).
Lessons learned	• Investments in the crop and participation of champions can enhance technology up-take – stakeholder linkages and participatory implementation is important. • Demonstration of the effect of integrated weed management in Teff using machines.
Social, environmental, policy and market conditions necessary	• Understanding the attitude of community towards weeding, household man-power endowment, Community youth, men, and women ratios.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Overall cost of production KES 31,000 per acre
Estimated returns	• Manual labour cost: KES 6000 per acre • Weeder Hire: KES 3000 per acre • Reduced labour cost: KES 3000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up.	• Motorized weeder is designed for easy start and operation hence it is gender friendly and can be used by women also • Women and youth have limited finances to pay services and to purchase a motorized weeder for use in the teff farms due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to so they might not be aware of the of motorized weeder • Men dominate most decisions at the household and community levels hence determines the type of farm equipment and machines to be used in teff farms facilities to be used in farms • Men have been drawn to weeding by the machine. • This task was predominantly for women before the introduction of the machine. • Culturally women are restricted to move around especially Muslim communities and they are likely

	to be disadvantaged because women work is strictly inside the houses so they might not get information of motorized weeder
Gender related opportunities	• Use of motorized machines can interest young men to do weeding reducing weeding work for women • Women stand to benefit from increased production due to nutritional benefits from Teff crop, grain sales and sales accrued from recipes. • Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to purchase teff motoralised weeder due to lack of access to credit facilities • VMGs have less access to information, technology and knowledge hence they might not be aware of a weed motoralised weeder • VMGs have limited finances to pay services and to purchase motorized sprayer due to limited access to credit facilities • Operating a motorized sprayer is complex for some VMGs especially those who are abled differently • Teff motorized weeder need to be designed in such a way that would enable people able differently to operate
VMG related opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMGs farmers • Increased production will lead to increased consumption of nutritious food hence improved health for VMGs • Increased income accrued from the sales of Teff will lead to economic empowerment of VMGs.
E: Case studies/profiles of success stories	
Success stories	No Kenya success stories
Application guidelines for users	Teff brochures, fliers, modules and manuals
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
F: Contacts	

Contacts	Yussuf k Aila; cellphone no;0723825061 ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Hottensiah Mwangi, Yussuf Aila &Lusike Wasilwa
Partner organizations	MoAL&F in Counties CBOs,NGOs Women groups;

2.7.3.5 TIMP Name	**Crop rotation for increased yield**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Various weed species occur dominating teff cropping systems and the soil weed banks are rich after years of replenishing with weed seeds. This happens when producers grow same crop such as Teff in same piece of land for consecutive years (monocropping).The biodiversity of weed species includes:

Nutsedge (*Cyperus rigidifolius* Steud.)

Goose grass or Wild finger millet (*Eleusine indica* (L.) Gaertn.)

	 Tar vine (*Boerhavia diffusa L.*)  Double thorn (*Oxygonum sinuatum* (Meisn.) Dammer among other weeds such as crows foot (*dactyloctenium aegyptium*)
What is it? (TIMP description)	Crop rotation of Teff (*Graminaea* family) is growing of different crops in succession on a piece of land to avoid land exhaustion of soil, control weeds, diseases and pests. Use of rotation with leguminous crop has advantages such as fixing nitrogen into the soil and covering the soil. This will manage weeds especially some difficult to control weeds like sedges, couch grass among others.
Justification	Farmers in Marsabit county have a habit of planting Teff in the same piece of land for consecutive years which has resulted to increase of some weed infestation build up leading to low teff productivity (grain yield and biomass). Crop rotation practice especially with legume crops can breakdown the cycle of weeds and increase productivity.
Region promoted	Marsabit county but it has high potential for other marginal counties
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers (farmers), extension agencies
Approaches to be used in dissemination	• Use of service providers, Tot, demonstrations, farmers tour
Critical/essential factors for successful promotion	• Farmers tour to knowledge from Ethiopia
Partners/stakeholders for scaling up	• NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	• Marsabit County
Counties where TIMPs can be up-scaled	• Marsabit , Isiolo, Mandera, Kitui, Makueni and other ASAL Counties

Challenges in development and dissemination	• Low publicity • Limited support from the county government and national government • Inadequate technology knowhow • Limited research inputs
Suggestions for addressing the challenges	• Enhance publicity by creating awareness. • Enhanced support from national and county government • Share knowledge and develop capacity of Technology knowhow • Invest in research IWM in Teff to generate knowledge.
Lessons learned in upscaling	• Availability of Cost benefit information that can attract farmers to engage into the activities but is not yet done.
Social, environmental, policy and market conditions necessary	• Understanding the attitude of community towards weeding; • Household man-power endowment. • Community youth, men, and women ratios
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000
Estimated returns	Grain seed loss without rotation: 200 Kg @110=KES 22,000
Gender issues and concerns in development, dissemination, in adoption scaling up	• Women are main players in Teff cultivation/weeding increasing the workload for women wo are highly burdened by their domestic roles at home • Women might not be aware that planting teff in rows is a way of controlling weed • Women and youth have limited access to production resources such as land, capital to purchase herbicides • Women have limited agricultural information and extension services so they might not be aware of crop rotation as a method of weed control • Crop rotation as a weed control method would only adopted by people who owns land
Gender related opportunities	• Use of crop rotation as a weed control reduces work for women • Women stand to benefit from increased production of teff leading to increased sales and profits • There is potential of increased food security and nutrition from increased Teff production • There is potential of employment for women and youth at every node of teff value chain • Reduces drudgery for women farmers as well as men

VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to information, technology and knowledge hence they might not be aware of crop rotation as a weed control method • 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 Teff technologies to the VMGs all aspects • VMG groups have limited access to product resources such as land so they would not be able to adopt the technology
VMG related opportunities	• Use of crop rotation as a weed control reduces work for VMGs • VMGs stand to benefit from increased production leading to increased sales and profits • There is potential of increased food security and nutrition from increased Teff production for VMGs • There is potential of employment for VMGs at every node of teff value chain
E: Case studies/profiles of success stories	
Success stories	A lot of success stories from American large scale farmers who have actually commercialized Teff farming. Teff has been developed in to so many products e.g. Teff porridge, Teff bread, Teff alcohol.
Application guidelines for users	Not yet developed
F. Status of TIMP readiness: 1. Ready for upscaling; 2. Require validation; and 3. Require further research	Ready for upscaling
G: Contacts	
Contacts	KALRO-Marsabit; Cell: 0723-825-061; Email: ailayussuf@yahoo.com
Lead organization and scientists	KALRO, Hottensiah Mwangi, Yussuf K. Aila and Lusike Wasilwa,
Partner organizations	County government and local NGOS

2.8. POSTHARVEST MANAGEMENT

2.8.1 TIMP Name	**Good harvesting methods**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Losses due to late harvest and inappropriate harvesting methods
 Traditional method of Harvesting of Teff using sickle.	This is a management practice involving proper timing of harvesting time by observing careful maturity indices which include colour changes from green to yellowish brown. This prevent shattering of grains from spikelet's and predisposing it to invasion by birds and other rodents. Teff is harvested at 1½ to 4 months after planting, depending on the varieties. Harvesting is done using sickles Manual harvesting is done by cutting with sickles. Farmers cut the plants at soil surface and pile them up in the field for drying *Mechanical harvesting* is possible by use of a combine harvester if the crop has matured uniformly.
Justification	Incorrect timing of harvesting and inappropriate harvesting methods leads to losses of Teff. Harvesting before the maturity of the crop results in lower yields and higher proportion of immature grain. Delay in harvesting results in grain shattering, head breakage and other losses caused by birds, rats, insects, moisture, etc.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors
Approaches used in	On farm and on station demonstrations, agricultural exhibitions and show
dissemination	field days • Agricultural shows • Extension officers • Partners (ICRISAT, NGOs) • 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 • Favorable policy encouraging utilization of underutilized and neglected species such as Teff
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production

	• Farmer leaders: Group organization • NGOs dealing with Teff to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Marsabit, Mandera, Isiolo, Wajir, Garissa, Makueni, Kitui
Challenges in dissemination	• Limited knowledge on Teff as a food crop in Kenya • Lack of knowledge on appropriate harvesting technology • Negative attitude by farmers towards adoption of new agricultural • TIMPs
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of farmers on appropriate harvesting through demonstration and exchange tours. • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up scaling	• Awareness of advantages of health benefits of Teff consumption • Target niche markets – gluten-free food market, celiac and diabetic patients, etc. • Frequent policy review to encourage consumption of underutilized crops such as Teff
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 31,000
Estimated returns	ksh 9900 less 2500 cost using the Timps therefore estimated return is ksh 7,400
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have limited access to productive resources such as land, credit facilities and equipment • In the target counties, Teff cultivation is mainly done by women increasing their work burden • Women loss their crops due to late harvesting as a result of being overworked • Women have no finances to pay for hired labor due to limited access to credits • Women are exploited by middle men and brokers due to limited market information and extension

	• The TIMP is easily adoptable after training and many farmers can use the management practice since it reduces losses incurred during and after harvesting.
Gender related opportunities	• The TIMP increases farm income through reduction of postharvest losses. • There is increased employment for women and youth • There is increased food security and nutrition for households
VMG issues and concerns in development, dissemination, adoption and scaling up	• It is labor intensive for some VMGs especially the PLWD and the sick. • VMGs lack access to information on new technologies and information • VMGs have no finances to hire labour due to limited access to credit facilities • Mechanical harvesting can be encouraged to all gender, including the VMGs.
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses, • This will enable VMGs to have enough Teff to consume, hence get macro- and micronutrients (especially minerals) • There will be more income for the farmers (VMGs)
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-
Application guidelines for users	Teff harvesting leaflets and manuals and brochure
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Ready for up scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Marsabit; P.O. Box 147-60500. Marsabit Email: ailayussuf@yahoo.com Phone: 0723825061
Lead organization and scientists	KALRO Yusuf Aila, Francis Wayua, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1 Validating maturity indices of the various Teff varieties / landraces
2 Quantification of the losses due to incorrect timing of the right maturity for harvesting different Teff varieties

3 Quantification of losses of manual vs. mechanical Teff harvesting, including the cost-benefit analyses of each method.

2.8.2 TIMP name	**Gotera (field drying of Teff before threshing)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to decay caused by inefficient drying and
	subsequent threshing losses
What is it? (TIMP description)  Gotera(Tula) – pile of Teff awaiting threshing in the field	This is piling of harvested Teff on raised wooden racks, with the panicles facing the Centre of the rack. The harvested Teff is left in the field usually for 2 to 7 days in order to dry and to prevent decay. During this time, the Teff should be protected from attack by animals, insects (termites), rodents and birds. Later they are collected and pilled on raised wooden rack.
Justification	A well dried Teff straw enhances threshing efficiency.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities - CGIAR's
Approaches to be used in dissemination	• Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	• Existence of effective extension services to demonstrate the technology • Strong partnership linkages • Accessibility and cost of the drying racks by farmers:

	• low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	• Extension service providers (Public and private) to help in the dissemination • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers, availability of tarpaulins • County governments – Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Marsabit
Challenges in dissemination	• Lack of knowledge on the technology
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers, and its importance in the Teff postharvest chain. • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling, if any	• -
Social, environmental, policy and market conditions necessary for development and up scaling	• Understanding the community culture, preferences, and practices • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 31,000
Estimated returns	Loses is 11/2 bags ksh 14,850 less the cost of technology ksh 2,000 Ksh 14,850 – 2,000 = ksh 14,850
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have limited access to productive resources such as land, credit facilities and equipment • Women might not be aware of Gotera (Field Drying of Teff before threshing) due to limited agricultural information and extension • • The TIMP is labour intensive especially for women who are who Who are involved in harvesting activity, this in away increases workload for women who are overburdened by their domestic chores • Women encounter post-harvest losses of teff due to inefficient drying methods

	• Women have no finances to pay for hired labour due to limited access to credits • The TIMP is easily adoptable after training, all genders can use the technology since it reduces losses incurred during drying
Gender related opportunities	• There will be employment for women and the youth during the TIMP implementation • The TIMP increases farm income through reduction of postharvest losses, hence increased food security and nutrition for households. • The TIMP also enhances food safety by preventing contamination of the harvested produce during drying
VMG issues and concerns in development, dissemination adoption and scaling up	• It is labor intensive for some VMGs especially the PLWD and the sick. • VMGs lacks access to information on new technologies and information • VMGs have no finances to hire labour due to limited access to credit facilities
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses and enhanced food safety • The technology can improve food and nutrition security and a window for increased income for VMGs. • The VMGs can participate in marketing of teff products
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications, leaflets and manuals
F: Status of TIMP readiness (Ready for upscaling, Requires validation, Requires further research)	Requires further research
G: Contacts	
Contacts	The Centre Director, KALRO-Marsabit; P.O. Box 147-60500. Marsabit Email: ailayussuf@yahoo.com Phone: 0723825061
Lead organization and scientists	KALRO Yusuf Aila, Francis Wayua, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF&I, NGOs, CBOs

2.8.3 TIMP Name	Use of hermetic storage bags for storage
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest storage losses of Teff resulting from poor quality storage facilities that are often made of mud plastered walls and floors exposing the grains to excessive moisture and rodent infestation.
What is it? (TIMP description)  Hermatic bags pictures	Hermetic bags are unlike regular jute bags or polypylene usually contains an inner rubber lining in which grains are placed so that they are air-tight and moisture-proof. This stops oxygen and moisture movement between the outside atmosphere and stored Teff grains that could lead in growth of moulds in the grains.
Justification	With proper management of Hermatic bag the store the grains can be stored for longer periods than the traditional method without the loss of quantity and quality. Hermetic bags are organic , ecofriendly and reusable.
	Farmers, wholesalers and retailers who practice storage will all benefit from this type of storage. Reducing post-harvest grain damage by rodents and moisture will help contribute to longer storability and longer food availability at household level and guarantee ensure quality of grain and better prices from markets. Use of hermetic storage technologies reduces use of chemicals thus promotes safe food. Hermetic Sealed bags. can be used repeatedly thus reducing cost of buying new bags every year. They can be used for multiple crops at different times.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff farmers, households, traders and transporters and National cereal and Produce boards off takers, schools and institutions
Approaches to be used in dissemination	Demonstrations, posters, brochures

Critical/essential factors for successful promotion	Presence of a functional supply chain or fabricators of the metallic silos in target areas.
Partners/stakeholders for scaling up and their respective roles.	East Africa Grain Council (EAGC), NGOs, Research organizations (KALRO, Universities); local jua kali artisans for fabrication of the metal silos
C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMPs will be upscaled	Marsabit
Challenges in dissemination	• Level of awareness of the effectiveness of the hermitic storage silos • Limited availability of the storage silos at nearest agro-dealer shops or artisan's workshops. High initial capital investment
Suggestions for addressing the challenges	• Step up promotion and demonstration especially with farmer groups • Strengthen the hermitic bags distribution networks to target farmers • Train youth to fabricate storage silos for the target groups and members. • Avail appropriate financing to farmers to enable acquisition of the metal silos
Lessons learned in up scaling, if any	Training on proper use is essential for optimal benefit from the hermitic storage silos. This includes proper drying of grain before storage and how to eliminate oxygen in silo before closing it.
Social, environmental, policy and	Need for credit arrangement or subsidy to make the silos
market conditions necessary for development and up-scaling	affordable to majority of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 31,000
Estimated returns	Loses is about 1/2bag equivalent to ksh 4,950 less cost of the technology ksh 200, the return is ksh 4,750
Gender issues and concerns in development, dissemination, adoption and scaling up	• Teff stakeholders especially women might not be aware of hermetic bags • Hermatic bags might not be available when the teff farmers want to use them. • Women loss their crops due to inefficient storage methods due to lack of hermetic bags

	• Women have no finances to pay for hermetic bags due to limited access to credits
Gender related opportunities	• Opportunities for youth in selling hermetic bags to farmers and traders • The TIMP increases farm income through reduction of postharvest losses and enhancing food safety, hence increased food security and nutrition for households.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs might not be aware of hermetic bags due to limited access to agricultural information and extension services • Hermetic bags might not be available when the VMGs farmers want to use them. • VMGs have no finance to buy hermetic bags due to limited access to credit facilities • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses and enhanced food safety • The technology can improve food and nutrition security and a window for increased income. • Opportunity for VMGs to engage in marketing of hermetic bags
E: Case studies/profiles of success stories	
Success stories	• Experiences from Ethiopia
Application guidelines for users	• Training materials, brochures, factsheets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute director, KALRO-Marsabit; P.O. Box 169-50100, Marsabit Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Aila, Y. Kisilu, R. Wayua, F. Ndambuki, J. Kirigua, V and Wasilwa L. Molu, S.
Partner organizations	Agricultural University Colleges, MoALF&I, NGOs, CBOs

Research Gaps

1. Requires validation with teff farmers in the target counties
2. Research on innovative investment options for farmers and farmer groups

3. Cost-benefit analysis of storing teff in metal silos

2.8.4 TIMP Name	**Metal Silo**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest storage losses of Teff resulting from poor quality storage facilities that are often made of mudplastered walls and floors exposing the grains to excessive moisture and rodent infestation.
What is it? (TIMP description)  Metal silos of various sizes	A metal silo is a cylindrical structure, constructed from galvanized iron sheet and hermetically sealed (air-tight and moisture-proof). Metal silos effectively protect stored grains from rodents, birds and moisture that results in growth of moulds in the grains.
Justification	With proper management of metal silos, the grains can be stored for longer periods than the traditional method without the loss of quantity and quality. With loss reduction of 75%, savings of US$ 24 per year can be achieved with a profit ability of US$ 7.4 per year. Farmers, wholesalers and retailers who practice storage will all benefit from this type of storage. Storage in silos will eliminate the use of chemicals to control pests assuring safety of the grains. Reducing post-harvest grain damage by rodents, birds and moisture will help contribute to longer storability of food availability at household level and guarantee ensure quality of grain and better prices from markets. Use of hermetic storage technologies reduces use of chemicals thus promotes safe food. Hermetic Sealed Metal Silo (Grain Storage Silos) can be used repeatedly thus reducing cost of buying new bags every year. They can be used for multiple crops at different times.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff farmers, households, been offtakers, schools
Approaches to be used in dissemination	• Demonstrations, posters, brochures
Critical/essential factors for successful promotion	• Presence of a functional supply chain or fabricators of the metallic silos in target areas.
Partners/stakeholders for scaling up and their respective roles.	• East Africa Grain Council (EAGC) • NGOs • Research organizations (KALRO Universities); local jua kali artisans for fabrication of the metal silos
C: Current situation and future scaling up	
Counties where already promoted if any	• Grain producing counties
Counties where TIMPs will be upscaled	• Marsabit, Isiolo, Mandera, Wajir, Tharaka Nithi, Kitui, Makueni
Challenges in dissemination	• Level of awareness of the effectiveness of the hermitic storage silos • Limited availability of the storage silos at nearest agrodealer shops or artisans workshops. • High initial capital investment
Suggestions for addressing the challenges	• Step up promotion and demonstration especially with farmer groups • Strengthen the hermitic bags distribution networks to target farmers • Train youth to fabricate storage silos for the target groups and members. • Avail appropriate financing to farmers to enable acquisition of the metal silos
Lessons learned in up scaling, if any	• Training on proper use is essential for optimal benefit from the hermitic storage silos. This includes proper drying of grain before storage and how to eliminate oxygen in silo before closing it.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Need for credit arrangement or subsidy to make the silos • affordable to majority of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• The capacity of the silos ranges from 1, 8, 12 and 1,000 bags.

	• The cost of the facilities ranges from KSh 3,000 for one bag capacity, KSh 15,000 for eight bags and KSh 24,000 for the 12 bags capacity among other prices. •
Estimated returns	• Loses is about ½ bag equivalent to ksh 4,950 + 2000 chemicals = KES 6950 less cost of the technology ksh 3000, the return is ksh 3,950
Gender issues and concerns in development, dissemination, adoption and scaling up	• Teff stakeholders especially women might not be aware of metal silos • Silos might not be available when the teff farmers want to use them. • Women loss their crops due to inefficient storage methods due to lack of Silos • Women have no finances to buy metal silos due to limited access to credits
Gender related opportunities	• Opportunities for youth in selling hermetic bags to farmers and traders • The TIMP increases farm income through reduction of postharvest losses and enhancing food safety, hence increased food security and nutrition for households.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs might not be aware of hermetic bags due to limited access to agricultural information and extension services • Hermetic bags might not be available when the VMGs farmers want to use them. • VMGs have no finance to buy hermetic bags due to limited access to credit facilities • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses and enhanced food safety • The technology can improve food and nutrition security and a window for increased income. • Opportunity for VMGs to engage in marketing of hermetic bags
E: Case studies/profiles of success stories	
Success stories	• Experiences from Ethiopia
Application guidelines for users	• Training materials, brochures, factsheets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling

G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1 Requires validation with teff farmers in the target counties
2 Research on innovative investment options for farmers and farmer groups
3 Cost-benefit analysis of storing teff in metal silos

2.8.5 TIMP name	Teff stores
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest storage losses of teff due to inappropriate storage
What is it? (TIMP description)	The TIMP includes a storage structure for storage of the bagged grains and ensures that the bags are not attacked by rodents. Bags should be placed on pallets, not directly on the floor. These can stay for at least 8 months while still in good condition. The storage structure also maintains the quality of the grain. The store can adopt acoustic technology to monitor and control insect infestation of the store. Practice First In First Out (FIFO) principle in stock management.
Justification	Traditionally, teff grains are stored in sacks or in mud plastered walls and floors. Losses occur due to attack by rodents and excessive moisture that leads to mould growth that reduce quality and is also a health risk. The technology on Teff stores reduces losses by maintaining the quality of stored grain, maintaining supply of grain, and enables farmers to bulk Teff during harvest season and sell the grains during the off seasons at higher prices
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, industrial and commercial processors

Approaches to be used in dissemination	• On-farm demonstration, exhibitions, agricultural shows, seminars, meetings, promotional materials • (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Have potential to reduce postharvest losses, increase food security and increase income generation but require functional institutional arrangements, strong management, and external injection of resources to kickoff the process; market linkages and group dynamics are key drivers. • Existence of effective extension services to demonstrate the technology • Grain to be stored must be in good condition for storage • Other destructive postharvest agents must be controlled, • e.g. rodents, rain, etc.
	• Favourable policy, encouraging better prices for high quality grain
Partners/stakeholders for scaling up and their roles	• Extension service providers (Public and private) to help in the dissemination • NGOs / CBOs • National and County governments (e.g. NCPB) - Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	• Major grain growing areas of Kenya
Counties where TIMPs will be upscaled	• Marsabit, Isiolo, Mandera, Wajir, Tharaka Nithi, Kitui, Makueni
Challenges in dissemination	• Lack of information • Lack of skills • Lack of credit to construct stores
Suggestions for addressing the challenges	• Capacity building of farmers, traders and extension agents • Provide appropriate financial services and credit facilities to small-scale farmers and traders
Lessons learned in up scaling, if any	• Partnership is important in technology dissemination • Extension training and regular monitoring are essential
Social, environmental, policy and market conditions necessary for development and up scaling	• Willingness of farmers to adopt good storage • Market able to absorb increased supply of quality grain • Good teff policy
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 31,000

Estimated returns	Loses is about 2 bags equivalent to KES 20,000 + 2000 chemicals = KES 22,000 Return is ksh 11,000
Gender issues and concerns in development, dissemination adoption and scaling up	• Teff stakeholders especially women might not be aware of good storage facilities • Stores might not be available when the teff farmers want to use them. • Women loss their crops due to inefficient storage methods • Women have no finances to built stores due to limited access to credits
Gender related opportunities	• Opportunities for youth in bulding stores to farmers and traders • The TIMP increases farm income through reduction of postharvest losses and enhancing food safety, hence increased food security and nutrition for households.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs might not be aware of stores due to limited access to agricultural information and extension services • Stores might not be available when the VMGs farmers want to use them. • VMGs have no finance to built stores due to limited access to credit facilities • VMGs due to their status are ignored when important decisions are being made relating to farming
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses and enhanced food safety • The technology can improve food and nutrition security and a window for increased income. • Opportunity for VMGs to engage in marketing of hermetic bags
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Extension publications
F: Status of TIMP readiness	
(1-Ready for upscaling, 2requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061

Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research gaps

1. Requires validation in different agro-ecological zones.

2.9 TEFF VALUE ADDITION

2.9.1 TIMP name	**Teff flour**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of Teff
What is it? (TIMP description)	Flour prepared from milling Teff grains  Source: Ndambuku, J.
Justification	The TIMP helps to reduce over-dependence of maize flour. Maize production has been negatively affected by climate change – e.g. Maize Lethal Necrosis Disease (MLND) and Fall Army Worm (FAW). Hence the need to diversify flour sources. Use of Teff flour is one such example. Diversification of Teff food products will enhance consumption of Teff and demand, thus spur increased production. Teff can be processed to make flour, which can either be fortified or used to make various other products including *injera*, *qita*, etc. Use of Teff flour will reduce over-reliance on maize flour for human nutrition in Kenya
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, small-scale processors / entrepreneurs, industrial and commercial processors
Approaches to be used in dissemination	• On-farm demonstration, • Field days, • Agricultural shows and exhibitions, • Promotional materials (posters/brochures/ leaflets), • Exposure tours to processing groups
Critical/essential factors for successful promotion	• Participatory implementation • stakeholder capacity building and networks • promotions involving Public Private Partnerships (PPP) • increased production of high-quality Teff • availability of quality standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale Teff processing facility • Extension service providers to help in the dissemination

	• KALRO – will train trainers and provide technical backstopping on dissemination of Teff flour production technology • KEBS – Standards formulation for Teff flour, certification of private Teff flour processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the Teff flour • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit, Mandera
Counties where TIMPs will be upscaled	Northern, Upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the technology by farmers, consumes and other value chain actors • Majority of the Kenyan population only recognizing maize as the staple food • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities
Suggestions for addressing the challenges	• Awareness creation about the product to the government agencies, farmers, and traders • Capacity building of farmers on how to use the products • Involvement of regulatory agencies and policy makers in up-scaling process • Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like Teff, focusing on the nutritional quality of Teff (gluten-free and rich in minerals). • Working with KEBS to develop standards for Teff flour • Linking farmers to credit facility providers to get capital to engage in Teff flour production agribusiness.
Lessons learned in up scaling, if any	• It would be good for farmer tours to processing groups to expose farmers to Teff flour production technology (e.g. exposure tours to Southern Ethiopia • Adequate capacity building is essential for technology adoption • Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. KEBS ensure processors are certified, and developed standards for Teff flour • Nutrition education and changing consumer behavior to incorporate Teff flour • Existing and new markets are developed and maintained • Policies on composite flours are developed and/or implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Milling equipment and infrastructure. KSh 10/- for milling 2 kg of Teff flour
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of Teff
Gender issues and concerns in development, dissemination adoption and scaling up	• Women might not aware of teff floor due to limited access to agricultural information and extension services • Women are the ones who are mainly involved in processing of teff products increasing their workload • Women have limited processing time due to limited mobility and exposure which is attributed to their busy schedule and domestic roles • Women have no funds to pay for processing and purchasing of materials for blending • Women, men and the youth should participate in technology demonstrations
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teff and its products
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs might not be aware of some teff products such as Teff flour • VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to processing of Teffs flour • VMGs have limited processing skills due to limited mobility and exposure. In addition they lack access to agricultural information and extension services • Processing work is labor intensive for some VMGs especially the abled differently
VMG related opportunities	• There is a potential of providing VMGs with diversified foods • Nutritious products can be made from Teff flour contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	Experiences from Ethiopia where farmers are processing Teff flour for making various products
Application guidelines for users	Baretto, R., Buenvista, R., Rivera, J., Wang, S., Prasad, V. and Siliveru. (2021). Teff (*Eragrostis tef*) processing, utilization and future opportunities: a review. *International Journal of Food Science and Technology*, 56: 3125-3137

	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Flour. KALRO/Value addition Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research gaps

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

2.9.2 TIMP Name	**Teff injera**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information on the type of food that can be made from Teff grain ahs led to low diversification of Teff food to different communities providing them less choices.
What is it? (TIMP description) *Preparing Injera after fermentation process Ready for consumption*	*Injera* is a sour fermented flat bread with a slightly spongy texture, traditional made from Teff flour by the Burji , Gabra and Boran communities in Northern Kenya. It is cooked by mixing Teff flour with water and fermenting with yeast *(Irsho*). The fermented paste is then heated on a flat shallow frying pan. It neither uses oil for frying nor is it heated on both sides as in *chapatti*. It can be sweetened with sugar or be salted. It is best eaten with a stew. It can also be consumed with tea in the morning.

	 *Preparing Injera after fermentation process ready for consumption*  *Injera* (Source: Lusike Wasilwa)
Justification	Diversifying Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production. This means increased income and improved health due to the high nutritive value of Teff.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, extension agencies, and consumers
Approaches to be used in dissemination	• On-farm experimentation • Agricultural shows and exhibitions • Exchange tours, recipe brochures
Critical/essential factors for successful promotion	• Availability of inputs • Well-organized farmer groups • Value addition trainers • Funding to invest in Teff value addition
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination

	• KALRO – will train trainers and provide technical backstopping on dissemination of Teff *injera* processing • KEBS – Standards formulation for Teff *injera*, certification of private processors • Private sector processors and restaurants • Households and institutions (e.g. schools and hospitals) will provide markets for the Teff *injera*
C: Current situation and future scaling up	
Counties where already promoted if any	Marsabit
Counties where TIMP will be up scaled	Northern, Upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the innovation by value chain actors • Teff is considered as a neglected and underutilized crop • Teff is not a registered crop in Kenya • Poor extension services and lack of technical knowhow
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, traders, consumers and other value chain actors • Promotional campaigns to register Teff; • Sensitization of regulatory agencies and policy makers; • Enhanced extension and research on Teff
Lessons learned	Market opportunities and nutrition education are essential for up-scaling of value added Teff products
Social, environmental, policy and market conditions necessary	• Changing consumer behaviour to incorporate Teff *injera* • Policies on value added Teff products are developed and / or implemented • Target women and youth in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 30/- per piece
Estimated returns	Enhanced nutrition status from increased consumption of injera; enhanced income from sale of injera
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not have the necessary skills to make injera due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make injera due to limited access to credit facilities

	• Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of injera is labor intensive hence increase labor form women • Women have limited markets to sell injera products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in during the technology demonstrations .
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of injera. • There will be improvement in food security and nutrition for women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have had limited markets to sell teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff products due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of teff since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP •
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs
E: Case studies/profiles of success stories	
Success stories	Experiences from Ethiopia and northern Kenya where farmers are processing injera.
Application guidelines for users	Abera, A., Milkesa, M. and Gebremedhin, H. (2016). Injera preparation from taro (Colocasia esculenta) and Teff (Eragrostis Teff) flour. *International Journal of Sciences: Basic and applied Research,* 30 (1): 196-204.

F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Optimization of the *injera* fermentation process
2. Determination of the nutritional composition of *injera*
3. Appropriate packaging and promotion technology
4. Conduct business and economic analyses of target markets for *injera*
5. Characterise the Teff varieties for their suitability for processing *injera*
6. Research on options for commercializing the product (linking with industry)

2.9.3 TIMP Name	***Qita***
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff grain
What is it? (TIMP description)	*Qita* is a thick pancake made of Teff as main ingredient. It can be mixed with wheat flour for dough formation. Can be eaten as snack or with a relish.  Teff qita (Source:Yusuf Aila and Lusike Wasilwa)

Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production of Teff and offer job opportunities to the idle youth. It will also solve perennial food insecurity currently addressed by food aid from donors.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, extension agencies, and consumers
Approaches to be used in dissemination	• On-farm experimentation • Agricultural shows and exhibitions • Exchange tours, recipe brochures
Critical/essential factors for successful promotion	• Availability of inputs • Well-organized farmer groups • Value addition trainers • Funding to invest in Teff value addition
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff *qita* processing • KEBS – Standards formulation for Teff *qita*, certification of private processors • Private sector processors and restaurants • Households and institutions (e.g. schools and hospitals) will provide markets for the Teff *qita*
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, Upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• *Qita* is known to people who are town dwellers but not known to herders and nomadic pastoralist communities; • Low publicity; • Lack of technology on optimal processing method
Suggestions for addressing the challenges	• Promotional and awareness creation campaigns about the product to herds, nomadic pastoralists and other consumers; • Capacity building of farmers on how to cook *qita*.
Lessons learned	• Teff has high nutritive value good health benefits especially for health conscious individuals and therefore there is need to register and recognize as Kenyan food crops. *Qita* is a good value added product addressing malnutrition with high potential to compete with imported products.
Social, environmental, policy and market conditions necessary	• There is need for nutrition education and changing consumer behavior to incorporate Teff qita • Development of good policy framework for Teff and Teff products

	• Develop and sustain good marketing structure even linking with Ethiopian traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 30/- per piece
Estimated returns	Enhanced nutrition status from increased consumption of injera; enhanced income from sale of injera
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not be aware that teff could be make products such as teff Qita • Women might not have the necessary skills to make teff Qita due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make teff Qita due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of teff Qita is labor intensive hence increases labor for women who are overburdened by their domestic chores
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff products such as Qita. • There will be improvement in food security and nutrition for women and youth • There is reduced post- harvest losses for potatoes
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	• VMGs have limited markets to teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff Qita due to limited access to agricultural information and extension services • VMGs lack finances to pay for materials used in Qita preparation due to limited access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs

E: Case studies/profiles of success stories	
Success stories	Experiences from Ethiopia and northern Kenya where farmers are processing qita.
Application guidelines for users	FAO (2018). Kenyan Food Recipes: A Recipe Book of Common Mixed Dishes with Nutrient Values as prepared by Communities. FAO/MoA, Kenya, Nairobi, Kenya
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Optimization of the *qita* fermentation process
2. Determination of the nutritional composition of *qita*
3. Appropriate packaging and promotion technology
4. Conduct business and economic analyses of target markets for *qita*
5. Characterise the Teff varieties for their suitability for processing *qita*
6. Research on options for commercializing the product (linking with industry)

2.9.4 TIMP Name	**Teff *Fiqe***
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff grain, and malnutrition in the Teff growing areas
What is it? (TIMP description)	*Fiqe* is a traditional balanced meal cooked by mixing Teff flour with little water with boiled beans and kales or *shalkeda* (moringa spp). It is best enjoyed with a strong cup of tea.

	 Fiqe (Source: FAO/MoA, 2018)
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production of Teff and offer job opportunities to the idle youth. It will also solve perennial food insecurity currently addressed by food aid from donors.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, extension agencies, and consumers
Approaches to be used in dissemination	• On-farm experimentation • Agricultural shows and exhibitions • Exchange tours • Recipe brochures
Critical/essential factors for successful promotion	• Availability of inputs • Well-organized farmer groups • Value addition trainers • Funding to invest in Teff value addition
Partners/stakeholders for scaling up	• Farmer groups – to be trained on *fiqe* processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff *fiqe* processing • KEBS – Standards formulation for Teff *fiqe*, certification of private processors • Private sector processors and restaurants • Households and institutions (e.g. schools and hospitals) will provide markets for the Teff *fiqe*
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Prejudice on products because it's believed to be poor people's food. • Lack of technology on optimal processing method

Suggestions for addressing the challenges	• Nutrition education, promotion campaigns, behavior change communication and demonstration on how to utilize. • Capacity building of farmers on how to cook *fiqe*
Lessons learned	• Teff has high nutritive value good health benefits especially for health conscious individuals and therefore there is need to register and recognize as Kenyan food crops. • *Fique* is a good value added product addressing malnutrition with high potential to compete with imported products.
Social, environmental, policy and market conditions necessary	There is need for nutrition education and changing consumer behavior to incorporate Teff *fiqe*. 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KSh 50/- per piece
Estimated returns	Enhanced nutrition status from increased consumption of *fiqe*; enhanced income from sale of *fiqe*
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not be aware that teff could be make products such as teff *fiqe* • Women might not have the necessary skills to make teff fige due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make teff *fiqe* due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of teff *fiqe* is labor intensive hence increases labor for women who are overburdened by their domestic chores
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff products such as teff *fiqe* • There will be improvement in food security and nutrition for women and youth • There is reduced post- harvest losses for teff
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	• VMGs have limited markets to teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff *fiqe* due to limited access to agricultural information and extension services

	• VMGs lack finances to pay for materials used in *fiqe* preparation due to limited access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	FAO (2018). Kenyan Food Recipes: A Recipe Book of Common Mixed Dishes with Nutrient Values as prepared by Communities. FAO/MoA, Kenya, Nairobi, Kenya
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

2.9.5. TIMP Name	**Teff cake**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff despite high nutritive value despite health benefits; Market opportunities for products are minimal

What is it? (TIMP description)	A snack food product made from Teff-wheat composite flour.  Teff cake – brown type (Source: Yussuf Aila and Lusike Wasilwa)
Justification	Teff utilization and consumption options are few among Teff growing communities. Teff traditional dishes are not palatable to youth and children. Promotion of value added products will enhance adoption and production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, extension agencies, and consumers
Approaches to be used in dissemination	• On-farm experimentation, agricultural shows and exhibitions, exchange tours, and recipe brochures
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	• Farmer groups – provide land for establishment of small-scale Teff processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff cake production technology • KEBS – Standards formulation for Teff cake, certification of private Teff cake processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the Teff cakes • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted if any	• None
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the technology by farmers • Prejudice on products of neglected crops • Difficulty in acquiring certificates from regulatory agencies; lack of quality standards for the product

	• Lack of credit facilities and appropriate packaging materials.
Suggestions 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. • Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like Teff, focusing on the nutritional quality of Teff (rich in minerals, gluten-free). • Working with KEBS to develop standards for Teff cake • Capacity building of farmers on how to cook Teff cake
Lessons learned	• It would be good for farmer tours to processing groups expose farmers to Teff cake production technology • Adequate capacity building is essential for technology adoption
Social, environmental, policy and market conditions necessary	• There is need for nutrition education and changing consumer behavior to incorporate Teff cake • Development of good policy framework for Teff and Teff products • Develop and sustain good marketing structure even linking with Ethiopian traders • The flour blending policy adopted recently will positively impact production of product
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Enhanced nutrition status from increased consumption of cake; enhanced income from sale of cake
Gender issues and concerns in development and dissemination	• Women might not aware of some products such as Teff cakes that they can be processed using Teff flour • Women also had limited skills relating to making Teff cakes. • Women have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations • Processing is mainly done by women, adding more work burden to them

Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to making Teffs cake • VMGs have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing work is labor intensive for some VMGs especially the abled differently • VMGs might not be aware of some products such as Teff flour that they could be processed using Teff • VMGs have limited knowledge on new technologies and information due to their status in the society
VMGs related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from Teff cake contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	None, but ToTs from Isiolo, Laikipa and Mandera trained on the technology
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Cake. KALRO/KCSAP Programme Factsheet No. #
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Require validation
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Identification of small-scale entrepreneurs in different counties
2. Appropriate packaging and promotion
3. Validation of requisite community baking ovens.
4. Characterizing the various Teff varieties for their cake production potential (for example, which variety produces the best quality cakes?)
5. Optimizing the Teff: wheat flour blending ratio and the cake production procedures
6. Providing data on cost-benefit analysis and gross margins for cake production

2.9.6 TIMP Name	**Teff porridge**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff products
What is it? (TIMP description)	Porridge made from a Teff-maize composite flour.  Teff porridge (Source: James Ndambuki)
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production of Teff.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, extension agencies, and consumer households
Approaches to be 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	• Availability of trainers, value addition trainers, stakeholder capacity building and networks; promotions involving Public Private Partnerships (PPP).
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff porridge preparation • Private sector processors and restaurants

	• Households and institutions (e.g. schools and hospitals) will provide markets for the Teff porridge
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Negative attitude of consumers towards Teff consumption
Recommendations for addressing the challenges	• Nutrition education, promotional campaigns; sensitization of households and food outlets to promote commercialization of Teff porridge.
Lessons learned	• Market opportunities and nutrition education are essential for up-scaling of value added Teff products
Social, environmental, policy and market conditions necessary for development and up scaling	• 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. • Persistent nutrition education and behavior change communication campaigns are critical to enhance consumption of Teff products.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Enhanced nutrition status from increased consumption of Teff porridge; enhanced income from sale of Teff porridge
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women were not aware of some products such as Teff porridge that they could be processed using Teff • Women also had limited skills relating to making Teff porridge due to limited mobility and exposure • Processing of teff is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations • Processing is mainly done by women, adding more work to them
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products

VMG issues and concerns in development, dissemination, adoption and scaling up.	• VMGs might not be aware of some products such as Teff porridge that they could be processed using Teff. • VMGs have limited knowledge on new technologies and information due to their status in the society • VMGs also have limited skills relating to making Teffs porridge • VMGs have limited processing skills due to limited mobility and exposure as they are usually left out when new technologies are being disseminated • Processing work is labor intensive for some VMGs especially those who are abled differently
VMG related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from Teff porridge contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	none
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Cake. KALRO/KCSAP Programme Factsheet No. #
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Require validation
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Further research is needed regards to variety effect on product.

2.9.7 TIMP Name	**Teff biscuit**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	

Problem addressed	Limited Teff utilization and minimal market opportunities for Teff products
What is it? (TIMP description) 	These are biscuits prepared from Teff-wheat composite flour.  Teff biscuit (Source: Lusike Wasilwa)
Justification	Teff utilization and consumption options are fe among growing communities. Teff traditional dishes are not palatable to youth and children. Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production and utilization of Teff.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, industrial and commercial processors
Approaches to be used in dissemination	• On-farm experimentation, training, and practical demonstration of preparation process, recipe brochures, exposure tours to processing groups
Critical/essential factors for successful promotion	• Availability of inputs • Well organized farmer groups • Value addition trainers • Funding to invest in Teff value addition • Changing consumer behaviour to embrace Teff as a nutritious food
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of the TIMP • KEBS – Standards formulation for Teff biscuit, certification of private processors • Private sector processors and restaurants • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the Teff biscuit • Financial institutions to provide funds for processors
C: Current situation and future scaling up	

Counties where already promoted if any	• None
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the innovation by value chain actors • Negative attitude of consumers towards Teff consumption • Unavailability of the required inputs close to farmers • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities • Resource poor farmers – lack of funds to invest in Teff value addition
Suggestions for addressing the challenges	• Awareness creation about the product to the government agencies, farmers, and traders • Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like Teff, focusing on the nutritional quality of Teff (rich in minerals, glute-free). • Working with KEBS to develop standards for Teff biscuit • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned	• Market opportunities are essential for up-scaling of value added products
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. There is need to maintain existing markets and explore additional ones.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Enhanced nutrition and income
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not be aware that teff could be make products such as biscuits • Women might not have the necessary skills to make teff biscuit due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make teff biscuits due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of teff biscuit is labor intensive hence increases labor for women who are overburdened by their domestic chores

Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff products such as biscuit. • There will be improvement in food security and nutrition for women and youth • There is reduced post- harvest losses for potatoes
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	• VMGs have limited markets to teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff biscuits due to limited access to agricultural information and extension services • VMGs lack finances to pay for materials used in biscuits preparation due to limited access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in teff are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs
E: Case studies/profiles of success stories	
Success stories	none
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Biscuit. KALRO/KCSAP Programme Factsheet No. #
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Validation in nutrient composition
2. Validation of community fabricated ovens and cutters.
3. Characterizing the various Teff varieties for their biscuit production potential (for example, which variety produces the best quality biscuits?)
4. Optimizing the Teff: wheat flour blending ratio and the biscuit making procedures
5. Providing data on cost-benefit analysis and gross margins for biscuit production

2.9.8 TIMP Name	**Teff Crackie**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff food products
What is it? (TIMP description)	Teff crackies is an extruded deep fried snack made from Teff-wheat flour dough passed through a noodle machine.   Source: James Ndambuki
Justification	Teff utilization and consumption options are few among many communities. Teff traditional dishes are not palatable to youth and children. Promotion of value added products will enhance adoption and production
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, restaurants, traders, and consumers
Approaches to be used in dissemination	• On-farm experimentation, ToT trainings, training and dissemination through value addition expose, field days, shows, farmer to farmer communication, recipe brochures, etc.
Critical/essential factors for successful promotion	• Existence of effective extension services to demonstrate the technology • Availability of quality Teff grain / Teff flour • Availability of quality standards and assured markets • Favourable policy promoting Teff consumption • Training on food safety and HACCP
Partners/stakeholders for scaling up	• MoA – Mobilize, train and exhibit the products • NGOs/CBOs – Mobilize, train and exhibit the products • Cooperatives – register and train youth and women groups and give loans

	• KEBS – certification of processing groups and development of quality standards
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the product by value chain actors • Limited processing technologies at the household level • Irregular supply of quality Teff grain
Recommendations for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors • Capacity building of farmers on how to prepare the product • Information dissemination – postharvest handling, value addition, and nutritional attributes of the product • Promote Teff production all year round
Lessons learned	• Availability of processing inputs locally close to farmers, market opportunities for value added products, and nutrition education are essential for up-scaling of value added Teff products
Social, environmental, policy and market conditions necessary	• Favourable consumers perception on acceptability of the product • Supportive policy in place (e.g. the flour blending policy) • Ability to meet KEBS quality standards
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not be aware that teff could be make products such as teff crackie • Women might not have the necessary skills to make teff crackie due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make teff crackie due to limited access to credit facilities • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of teff crackie is labor intensive hence increases labor for women who are overburdened by their domestic chores
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff products such as crackie. • There will be improvement in food security and nutrition for women and youth

	• There is reduced post- harvest losses for potatoes
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	• VMGs have limited markets to teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff crackie due to limited access to agricultural information and extension services • VMGs lack finances to pay for materials used in crackie preparation due to limited access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Crackie. KALRO/KCSAP Programme Factsheet No. #
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1 Validation in nutrient composition
2 Identification of small scale entrepreneurs in different counties

3 Characterising the various Teff varieties for their crackie production potential (for example, which variety produces the best quality crackie?)
4 Optimising the Teff: wheat flour blending ratio and the crackie making procedures
5 Providing data on cost-benefit analysis and gross margins for crakie production

2.9.9 TIMP Name	**Teff Chapatti**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilization of Teff
What is it? (TIMP description)	Teff/wheat chappati This is a flat bread made from composite flour of 30% Teff and 70% wheat flour. It can be served as part of a meal with accompaniments such as vegetables, legumes, meat stews and desired beverages.  Source: James Ndambuki
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production of Teff. Bledning Teff with wheat flour will reduce the cost of chapatti and diversify the use of Teff. This will create demand for increased Teff production for enhanced food security and income. It will also save on money used to import wheat. Currently, Kenya imports over 50% of her wheat.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, industrial and commercial processors
Approaches to be used in dissemination	• On-farm demonstrations, field days, agricultural shows and exhibitions, training workshops, recipe brochures
Critical/essential factors for successful promotion	• Existence of effective extension services to demonstrate the technology • Availability of quality Teff grain / Teff flour • Availability of quality standards and assured markets • Favourable policy promoting Teff consumption • Training on food safety and HACCP
Partners/stakeholders for scaling up	• MoA – Mobilize, train and exhibit the products • NGOs/CBOs – Mobilize, train and exhibit the products

	• Cooperatives – register and train youth and women groups and give loans • KEBS – certification of processing groups and development of quality standards
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the product by farmers and consumers • Limited processing technologies at the household level • Irregular supply of quality Teff grain • Negative attitude / perception towards the product
Recommendations for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors • Capacity building of farmers on how to prepare the product • Information dissemination – postharvest handling, value addition, and nutritional attributes of the product • Promote Teff production all year round • Explain the benefits of the product (nutritional and health aspects – high in minerals, gluten-free) • Exchange visits to benchmark
Lessons learned	• Market opportunities are essential for up-scaling of value added products
Social, environmental, policy and market conditions necessary	• Favourable consumers perception on acceptability of the product • Supportive policy in place (e.g. the flour blending policy) • Ability to meet KEBS quality standards • Training on food safety and HACCP • Enabling policy standards that encourage Teff blending with other flours
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination adoption and scaling up	• Teff stakeholder might not be aware that teff could be used to make chapatis • Women might not have the necessary skills to make teff chapatis due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men

	• Making of chapatis is labor intensive hence increase labor form women • Women have limited markets to sell teff products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff chapatis • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for teff
VMG issues and concerns in development and dissemination adoption and scaling up	• VMGs have had limited markets to sell teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff skills due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of teff s since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in teff are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	Was successfully promoted by GTZ in Marsabit mountain
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Chapatti. KALRO/KCSAP Programme Factsheet No. #
F: **Status of TIMP Readiness (**1. Ready for upscaling; 2. Requires validation; 3. Requires further research**)**	Requires validation

F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Development of standard recipes and appropriate packaging and promotion
2. Appropriate packaging and promotion
3. Validation in nutrient composition
4. Identification of small scale entrepreneurs in different counties
5. Characterizing the various Teff varieties for their chapatti production potential (for example, which variety produces the best quality Chapatti?)
6. Optimizing the Teff-wheat flour blending ratio and the Chapatti making procedures
7. Providing data on cost-benefit analysis and gross margins for Chapatti production

2.9.10 TIMP Name	Teff mandazi
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited Teff utilization food products
What is it? (TIMP description)	Teff *mandazi* is a fried snack prepared from a Teff-wheat flour blend.  Teff *mandazi* (Source: Lusike Wasilwa)
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production and utilization of Teff.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, industrial and commercial processors

Approaches to be used in dissemination	• Farmers, traders, restaurants, small-scale processors / entrepreneurs, industrial and commercial processors
Critical/essential factors for successful promotion	• Availability of inputs • Well organized farmer groups • Value addition trainers • Funding to invest in Teff value addition • Changing consumer behaviour to embrace Teff as food
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of the TIMP • KEBS – Standards formulation for Teff *mandazi*, certification of private processors • Private sector processors and restaurants • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the Teff *mandazi* • Financial institutions to provide funds for processors
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Prejudice on products of orphan crops due to colour;
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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Enhanced nutrition and income
Gender issues and concerns in development and dissemination adoption and scaling up	• Teff stakeholder might not be aware that teff could be used to make mandazi • Women might not have the necessary skills to make teff mandazi due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of mandazi is labor intensive hence increase labor form women

	• Women have limited markets to sell teff products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff mandazi • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for teff
VMG issues and concerns in development and dissemination adoption and scaling up	• VMGs have had limited markets to sell teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing teff mandazi due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of teff since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in teff are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	none
Application guidelines for users	Ndambuki, J., Wayua, F. and Wasilwa, L. (2021). Teff Chapatti. KALRO/KCSAP Programme Factsheet No. #
F: **Status of TIMP Readiness (**1. Ready for upscaling; 2. Requires validation; 3. Requires further research**)**	Requires validation
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega

	Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1 Validation in nutrient composition
2 Characterizing the various Teff varieties for their *mandazi* production potential (for example, which variety produces the best quality *mandazi*?)
3 Optimizing the Teff: wheat flour blending ratio and the *mandazi* making procedures
4 Providing data on cost-benefit analysis and gross margins for mandazi production

2.9.11 TIMP Name .	**Teff flour yoghurt thickener (for camel yoghurt)**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited Teff utilization food products. Poor texture of fermented camel milk such as yoghurt
What is it? (TIMP description)	A snack food product made from a Teff – wheat flour blend.
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production and utilization of Teff.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension agencies, traders, and consumers
Approaches to be 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	• Availability of inputs • Well-organized farmer groups • Value addition trainers • Funding to invest in Teff value addition
Partners/stakeholders for scaling up	• Farmer groups – to be trained on Teff processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of the TIMP • KEBS – Standards formulation for Teff yoghurt thickener, certification of private processors • Private sector processors and restaurants

	• Households and institutions (e.g. schools and hospitals) will provide markets for the product
C: Current situation and future scaling up	
Counties where already promoted if any	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Lack of information on the recipes and standards
Suggestions for addressing the challenges	• Promotional campaigns; sensitization of policy makers; to promote consumption and commercialization. Development of standards, continued research on Teff
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. Adherence to Food safety and Public health regulations
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination adoption and scaling up	• Teff stakeholder might not be aware that teff could be used to make **Teff yoghurt thickener** • Women might not have the necessary skills to make **Teff yoghurt thickener** due to limited access to agricultural information and extension services • Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of **Teff yoghurt thickener** is labor intensive hence increase labor form women • Women have limited markets to sell teff products due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of **Teff yoghurt thickener** • There will be improvement in food security and nutrition for women and youth • There is reduced post harvest losses for teff

VMG issues and concerns in development and dissemination adoption and scaling up	• VMGs have had limited markets to sell teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing **Teff yoghurt thickener** due to limited access to agricultural information and extension services • VMGs lack finances to pay for value addition of teff s since they do not have access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in potato are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of potatoes for VMGs
E: Case studies/profiles of success stories	
Success stories	A new teccnology therefore success stories are expected with validation
Application guidelines for users	Teff Mandazi production leaflet
F: **Status of TIMP Readiness (**1. Ready for upscaling; 2. Requires validation; 3. Requires further research**)**	Require further research
F: Contacts	
Contacts	The Centre Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Mercyline Orayo, Harun Odhiambo, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

1 **Research Gaps** Optimising the Teff yoghurt thickener making procedures

2.9.12 TIMP name	**Whole-grain Teff breakfast cereal**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	

Problem addressed	Limited Teff utilisation products
What is it? (TIMP description)	This is breakfast cereal prepared by toasting and cooking whole Teff grains. This can be eaten warm at breakfast, just like oat meal, and its nutty flavour also goes well with all the usual oatmeal toppings, like fresh fruit and milk.  
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus spur increased production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, restaurants, extension agents, small-scale processors, industrial and commercial processors
Approaches to be used in dissemination	• On-farm experimentation, agricultural shows and exhibitions, exchange tours, recipe brochures
Critical/essential factors for successful promotion	• Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality Teff, availability of quality standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale Teff processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of the TIMP • KEBS – Standards formulation for Teff breakfast cereal, certification of private processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the product

	• Financial institutions – provide funding for investment in processing activities
C: Current situation and future scaling up	
Counties where already promoted if an	• Marsabit
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the technology by value chain actors • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities
Suggestions for addressing the challenges	• Awareness creation about the product to the government agencies, farmers, and traders • Capacity building of farmers on how to prepare and use the products • Involvement of regulatory agencies and policy makers in up-scaling process • Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like Teff, focusing on the nutritional quality of Teff (rich in minerals, gluten-free). • Working with KEBS to develop standards for Teff cakes
Lessons learned in up scaling, if any	• It would be good for farmer tours to processing groups expose farmers to Teff breakfast cereal production technology • Adequate capacity building is essential for technology adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. Develop and sustain good marketing structure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholder might not be aware that teff could be make products such as whole-grain Teff breakfast cereal • Women might not have the necessary skills to make whole-grain Teff breakfast cereal due to limited access to agricultural information and extension services • Women lack finances to purchase the materials required to make whole-grain Teff breakfast cereal due to limited access to credit facilities

	• Most farmer groups are composed of women and this may leave out the opinion and interests of men • Making of whole-grain Teff breakfast cereal is labor intensive hence increases labor for women who are overburdened by their domestic chores
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of teff products such as whole-grain Teff breakfast cereal • There will be improvement in food security and nutrition for women and youth • There is reduced post- harvest losses for teff
VMG issues and concerns in development, dissemination concerns in adoption and scaling up	• VMGs have limited markets to teff products due to limited mobility and exposure • Lack of participation by all VMGS hence they might not have skills and knowledge of processing whole-grain Teff breakfast cereal due to limited access to agricultural information and extension services • VMGs lack finances to pay for materials used in biscuits preparation due to limited access to credit facilities • Communication barriers for some VMGs who might not be able to communicate during agricultural workshops and meeting since there limited sign language interpreter to assist them hence limiting their adoption of the TIMP
VMG related opportunities	• There will be employment for VMGs in processing and selling of the diversified products • The micro-nutrients in teff are particularly healthy for persons with HIV/AIDS • Nutritious products can be made from teff flour contributing to the nutrition of VMGs. • Reduced post-harvest losses of teff for VMGs
E: Case studies/profiles of success stories	
Success stories	A new teccnology therefore success stories are expected with validation
Application guidelines for users	Baretto, R., Buenvista, R., Rivera, J., Wang, S., Prasad, V. and Siliveru. (2021). Teff (*Eragrostis tef*) processing, utilization and future opportunities: a review. *International Journal of Food Science and Technology*, 56: 3125-3137

F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

2.9.13 TIMP name	**Teff beer**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited Teff uptake in the market resulting in low prices utilization of food products
What is it? (TIMP description)	Lager beer made from Teff 
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus leading to increased production and utilization of Teff. Utilization of Teff in brewing with save on the foreign exvhange used to import barley for beer making in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, breweries
Approaches to be used in dissemination	• On-farm demonstrations, training workshops, promotional materials (posters/brochures/leaflets), exposure tour to processing factories
Critical/essential factors for successful promotion	• Availability of inputs • Well organized farmer groups

	• Value addition trainers • Funding to invest in Teff beer processing
Partners/stakeholders for scaling up and their roles	• Farmer groups – to be trained on Teff lager beer processing • Extension service providers to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff beer processing • KEBS – Standards formulation for Teff beer, certification of private Teff beer processors • Private sector processors and brewers – to create market for Teff • National and County governments
C: Current situation and future scaling up	
Counties where already promoted if any	• None
Counties where TIMP will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the innovation by value chain actors • Unavailability of required inputs close to farmers • Lack of funds to invest in Teff beer production
Suggestions for addressing the challenges	• Capacity building of farmers and processors on beer processing; Avail appropriate funding to invest in Teff beer production
Lessons learned in up scaling, if any	• Market opportunities are essential for up-scaling of value added products.
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. KEBS ensure brewers are certified; and develop standards for Teff beer • Existing and new markets are developed and maintained • Policies on alcoholic drinks from Teff are developed and / or implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Enhanced income
Gender issues and concerns in development and dissemination	• Women might not aware of some products such as Teff beer that they can be processed using Teff flour • Women also had limited skills relating to making Teff beer. • Women have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles

	• Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations • Processing is mainly done by women, adding more work burden to them
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to making Teffs beer • VMGs have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing work is labor intensive for some VMGs especially the abled differently • VMGs might not be aware of some products such as Teff beer that they could be processed using Teff • VMGs have limited knowledge on new technologies and information due to their status in the society
VMGs related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from Teff beer contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	Successful Teff beer producing companies in Ethiopia
Application guidelines for users	Extension publications
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061

Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

2. Identification of the specific Teff variety ideal for beer processing

2.9.14 TIMP Name	**Teff Pop Product**
Category (technology, innovation and management practice)	Innovation
A Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of Teff food products
What is it? (TIMP description)	This is a snack prepared by frying whole grain Teff in a deep sauce pan or a popping machine until they burst or puff. It is often served as a breakfast cereal or snack. It can be added into stews, salads or baked products.  Source: James Ndambuki
Justification	Diversification of Teff food products will enhance consumption of Teff, enhance demand and thus leading to increased production and utilization of Teff. It will also increase the human nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff farmers, extension agents, small-scale processors / enterprenuers, traders and consumers
Approach used in dissemination	• Field exhibits, agricultural shows, ToTs training workshop, recipe brochures
Critical/essential factors for successful promotion	• Availability of inputs • Well organized farmer groups • Value addition trainers • Funding to invest in Teff value addition
Stakeholders for scaling up and their roles	• 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
C: Current situation and future scaling up	
Counties where already promoted if any	• Not yet
Counties where TIMPs will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the innovation by value chain actors • Prejudice on products of orphan crops; difficulty in acquiring requisite standards certificates from • Resource poor farmers – lack of funds to invest in Teff value addition
Suggestions for addressing the challenges	• Train farmers on production and processing of Teff pops; • Linkage to credit facility providers
Lessons learned from up scaling if any	• Market opportunities are essential for up-scaling of value added Teff products
Social, environmental, policy and market conditions necessary for development and up scaling	• Existing and new markets are developed and maintained • Policies on value added Teff products are developed and / or implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet
Estimated returns	Enhanced nutrition and income
Gender issues and concerns in development and dissemination	• Women might not aware of some products such as teff pop that they can be processed using Teff flour • Women also had limited skills relating to making teff pop product. • Women have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations

	• Processing is mainly done by women, adding more work burden to them
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to making teff pop • VMGs have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing work is labor intensive for some VMGs especially the abled differently • VMGs might not be aware of some products such as teff pop that they could be processed using teff • VMGs have limited knowledge on new technologies and information due to their status in the society
VMGs related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from teff pop contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Some households are consuming Teff products after training in value addition. More urban families are consuming Teff due to health awareness creation
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-Kakamega; P.O. Box 169-50100, Kakamega Email: francis.wayua@gmail.com Phone: 0723825061
Lead organization and scientists	KALRO Francis Wayua, Yusuf Aila, James Ndambuki, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Identification of the specific Teff variety for pop processing

2.9.15 TIMP name	**Teff Hay**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Scarcity of livestock feeds, especially during dry season
What is it? (TIMP description)	This is hay prepared from Teff biomass after harvesting the grains.  
Justification	Scarcity of feeds during dry season limits livestock productivity especially ASAL Conserved hay from harvested Teff will alleviate the deficit especially during the dry season. The hay from Teff is very nutritious and can increase animal productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extensions agents, traders and livestock stakeholders
Approaches to be used in dissemination	• On-farm demonstration, field days, • agricultural shows and exhibitions, • promotion of training materials (posters/brochures/leaflets), exposure tours to processing groups
Critical/essential factors for successful promotion	• Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality Teff, right stage of harvesting to establish quality hay.
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale Teff hay processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff hay production.
C: Current situation and future scaling up	

Counties where already promoted, if any	• Not yet
Counties where TIMPs will be up scaled	• Northern, upper eastern and lower eastern arid and Semi aris counties were teff can grow
Challenges in dissemination	• Limited awareness of the technology by farmers • Difficulty in acquiring enough quantity of hay due to limited cultivation of Teff.
Suggestions for addressing the challenges	• Awareness creation about the product to the value chain actors • Capacity building of farmers on how to make hay from Teff
Lessons learned in up scaling, if any	• Field excursion to other Teff producing areas for learning and exposure in hay production • Adequate capacity building is essential for technology adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Target women and youth as entrepreneurs in society who are the major adopters.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet
Estimated returns	Increased income
Gender issues and concerns in development and dissemination	• Women might not aware of some products such as teff hay that they can be processed using Teff flour • Women also had limited skills relating to making teff hay. • Women have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations • Processing is mainly done by women, adding more work burden to them
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to making teff hay • VMGs have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing work is labor intensive for some VMGs especially the abled differently • VMGs might not be aware of some products such as teff hay that they could be processed using teff • VMGs have limited knowledge on new technologies and information due to their status in the society
VMGs related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from teff hay contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	Teff produces high biomass yields compared to other range grasses
Application guidelines for users	Hay production manuals
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO-Marsabit; P.O. Box 147-60500. Marsabit Email: ailayussuf@yahoo.com Phone: 0723825061
Lead organization and scientists	KALRO Yusuf Aila, Naftali Ondabu, Harun Odhiambo
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

2.9.16 TIMP name	**Teff Silage**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Scarcity of livestock feeding during dry season

What is it? (TIMP description)	This is silage made from Teff biomass 
Justification	Conserved silage from harvested Teff will alleviate the deficit. The silage from Teff is very nutritious. It can feed a wide range of livestock including beef, dairy and sheep especially feed lotting during dry season. It is labour intensive and will require research to ease the feeding operation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Traders • Extension agents • Livestock keepers • Machine manufacturers
Approaches to be used in dissemination	• On-farm demonstration of silage making and feeding • Field days • Agricultural shows and exhibitions • MoA/Extension officers • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Participatory implementation • Stakeholder capacity building and networks, • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality right stage of harvesting to establish quality standards.
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale Teff silage processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of Teff Silage production. Other technologies of Silage products will be demonstrated, these include: silage making and feeding management.
C: Current situation and future scaling up	
Counties where already promoted, if any	• Not yet

Counties where TIMPs will be upscaled	• Marsabit, Mandela, Isiolo, Wajir, Kitui, Makueni, Machakos, Laikipia, Baringo
Challenges in dissemination	• Limited awareness of the technology by farmers • Difficulty in getting enough silage materials
Suggestions for addressing the challenges	• Awareness creation about the product to the government agencies, farmers, and traders • Capacity building of farmers on how to use the silage • Working with KEBS to develop standards for Teff silage. • Linking farmers to credit facility providers to farmers on silage making
Lessons learned in up scaling, if any	• It would be good for farmer tours to large scale farms which have adopted silage feeding technology. • Adequate capacity building is essential for technology adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Willinness of livestock farmers to adopt teff as a forage crop • Teff will adapt to the ecological conditions of the target zones • Women and youth will be targeted as entrepreneurs in society who are the major adopters • Teff policy will be developed and implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet
Estimated returns	Not yet
Gender issues and concerns in development and dissemination	• Women might not aware of some products such as Teff silage that they can be processed using Teff flour • Women also had limited skills relating to making Teff silage. • Women have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing is mainly done by women, who have limited access and control of resources such as finances to purchase products for blending • Women, men and the youth should participate in technology demonstrations • Processing is mainly done by women, adding more work burden to them
Gender related opportunities	• Improves marketability of Teff due to diversified products • There is increased food security and nutrition • There will be employment for women and youth from the sale of Teffs and its products

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs lacks access to information on new technologies and information • VMGs also have limited skills relating to making Teffs silage • VMGs have limited processing skills due to limited mobility and exposure due to their busy schedule and domestic roles • Processing work is labor intensive for some VMGs especially the abled differently • VMGs might not be aware of some products such as Teff silage that they could be processed using Teff • VMGs have limited knowledge on new technologies and information due to their status in the society
VMGs related opportunities	• VMGs have diversified diet and generate income at village level by making the products for sale • Nutritious products can be made from Teff silage contributing to the nutrition of VMGs. • There is potential for employment for VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Silage making manuals
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Marsabit; P.O. Box 147-60500. Marsabit Email: ailayussuf@yahoo.com Phone: 0723825061
Lead organization and scientists	KALRO Yusuf Aila, Naftali Ondabu
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

2.10. MECHANIZATION OF TEFF PRODUCTION ACTIVITIES

2.10.1. TIMP Name	**Power tiller**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Teff commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source; Nasirembe, ATDC Siakago 2021)	A Power tiller is a low powered two-wheeled agricultural implement, also referred to as a walking tractor 8-16hp that can be fitted with a rotary tiller, disk harrow, mouldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete one hectare per day by one operator in about two hours though the machine could do more with a different operator. This will vary depending on the climatic conditions, soil types, soil moisture content, operator stamina and experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation soil, sowing seed, planting seed, spraying fertilizer, 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 manoeuvrability of conventional tractors and manual Labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff farmers and researchers
Approaches to be used in dissemination	• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	• KALRO, Universities (for information) • Machinery fabricators • NGO supporting farmers for dissemination

C: Current situation and future scaling up	
Counties where already promoted if any	• Non
Counties where TIMP will be up scaled	• Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Power tiller is not gender friendly especially for women • Power tiller would make work easier for women but women will not be able to purchase the equipment due to lack of finances due to limited access to credit facilities • Teff tilling equipment should be designed for easy start and operation by all gender. • Up-scaling should target all the gender and it should be affordable to all gender • Women have limited access and control of productive resources such as land , information, farm equipment and credits
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Power tiller increases participation of household members in tilling teff farms that is women, men and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating power tiller is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge so they might have information of the equipment

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

2.10.2. TIMP Name	**4 Wheeled Tractor 50Hp**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Teff commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour

What is it? (TIMP description)  (Source; Nasirembe, ATDC Siakago 2021)	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, water pump or chisel at alternate times for easing farm operations. It can complete 4 hectares per day by one operator but can have two operators to run another 8 hours of 4 hectares coming to 8 per day. This will vary depending on the climatic conditions, soil types, soil moisture content and operator experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation soil, sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for threshing through a power take off device and transporting produce. Farm sizes less than one hectare may limit manoeuvrability of conventional tractors and manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff farmers and researchers
Approaches to be used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery dealers NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of tractors • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1,780,000,00
Estimated returns	KES 450,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• The 4 wheeled tractor 50Hp is gender unfriendly hence it cannot be operated by women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities such as 4 wheeled tractor 50Hp • Men dominate most decisions at the household and community levels hence they make decisions relating to land preparation for teff farms • Teff farming machines should be designed for easy start and operation for all gender • Up-scaling should target all the gender • The is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • Promotes inclusivity of all genders
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating 4 wheeled tractor 50Hp is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not know where to get such tractors • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to purchase the tractor since it is affordable and easy to maintain machines
VMG related opportunities	• Creates employment at production, transportation, processing and distribution for VMGs • Reduces drudgery for VMG farmers

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.3. TIMP Name	**Mouldboard Plough**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Potato commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description) 	Mouldboard plough is an agricultural implement and is generally considered to be the important tillage implement. 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.

(Source; https://africa-agriexpo.com)	
Justification	High Efficiency. When well-adjusted, the plough automatically seeks the desired depth. It is Versatility. The various models have different features that enable high efficiency in preparation of the land. Weed Control. Pest Control. Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Potato farmers and researchers
Approaches to be used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 550,000
Estimated returns	KES 180,000/ month gross income
	•
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities

	• Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in their farms • Mouldboard plough is especially women and also expensive to purchase • Teff farming machines should be designed for easy start and operation by all gender. • Up-scaling should target all the gender • There is need to equip women, youth and stakeholders with information relating to the TIMP • Linking the women and youth to financial institutions would enable them to buy since it is affordable and easy to maintain machines
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating mouldboard plough is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.4.TIMP Name	Disc Harrow
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Teff commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)  Source; https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.svg	It is an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up clods, remove weeds, and cover seed and is a cultivating tool set with used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.
Justification	• Creating of a crumbly layer for planting is tedious. • It is not possible to manually protect the soil surface from rapid drying. • Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken. • Manual operation will reduce microbiological processes in the soil • Manual land harrowing Improving of nutrient availability to plants.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff farmers and researchers
Approaches to be used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost

Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Disk Harrow is gender unfriendly especially for women to operate • The machine is expensive for teff pea stakeholders to purchase especially women • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • Disk harrow should be designed for easy start and operation. • Up-scaling should target all the gender • The is need to equip women, youth and stakeholders with information relating to the TIMP
Gender related opportunities	• Creates employment especially for youth

	• Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Operating a disk harrow is complex for some VMGs especially those who are abled differently • VMGs have less access to agricultural information, technology and knowledge hence they might not be aware of the existence of a disk harrow and how it is operated • VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • VMGs need to be equipped with information relating to the TIMP • Farm machines need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordability and easy to maintain machines for all types of farmers
VMGs opportunities	• Creates employment especially for VMGs • Reduces drudgery for VMG farmers
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.5. TIMP Name	**Seed driller**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seed placement

	• Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source Model RS - Rice Seed Drill, Lieve vrouwepoldersedijk 1A , Stad aan `t Haringvliet , 3243 Netherlands)	A seed drill is a device used in agriculture that meters, sows seed for crops by positioning them in the soil and burying them to a specific depth. The seed drill sows the seeds at the proper seeding rate and depth, ensuring that the seeds are covered by soil.
Justification	• Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Teff see is very small making planting depth critical and difficult to attain when manually done and seed deeply planted too deep may not germinate • Raw planting increases yields, easy to manage weeds and pests, 20 t0 50kg per hectare and more importantly timely and low labour requirement,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff farmers and researchers
Approaches to be used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines

Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
	•
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women are involved in all activities along the teff value chain especially planting and weeding. Men are rarely involved in these activities because they involve bending • Machines such as teff seed drill makes it easy to plant teff for all genders • Teff **seed drill** is expensive for teff farmers especially women and youth to purchase • Women and youth have limited finances to pay services and to purchase farm equipment such as teff drill due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization including teff driller. • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • Teff driller should be designed for easy start and operation. • Up-scaling should target all the gender and they should be affordable to all gender
Gender related opportunities	• High productivity increasing food security and nutrition for women and youth • Creates employment especially for youth • The TIMP attracts all genders into planting of teff • Reduces drudgery for all gender farmers while planting teff
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as teff drillers due to limited access to credit facilities • Operating a teff driller is complicated for some VMGs especially those who are abled differently to operate

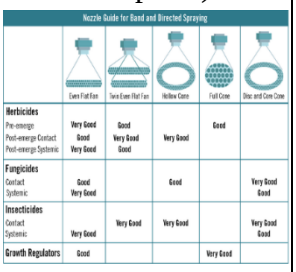
	• VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to buy teff driller since it is affordable and easy to maintain • Teff driller need to be designed in such a way which would enable people able differently to operate • In addition they should to be affordable
VMG related opportunities	• High productivity increasing food security and nutrition for VMGs • Creates employment especially for VMGs • Teff driller makes teff planting easy for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.6. TIMP Name	**Roller**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Teff commodity

	• Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)  (Source:https://i.pinimg.com/736x/bd/a6/7e/ --garden-products-gardening-tools.jpg)	The perfect complement to precision seeders. Heavy duty lobster trap wire covers three independent cylindrical rollers that provide a slip differential to prevent ploughing the soil when turning at the end of the row. A ganging rod ties them together preserve spacing for marking rows and dibbling operations. 1" trap wire mesh is spaced close enough to break up smaller clumps and dirt clods but wide enough to resist getting clogged with soil and mud. Handle is adjustable laterally to allow operation in-row or from either footpath. A metal rack on top can accept additional weight if needed. May be pulled or pushed.
Justification	Land preparation for teff requires a fine tilth and makes soil susceptible to erosion. loose soil will not squarely pack with seed and makes it difficult to transfer moisture from soil to the seed to start germination process. Rolling increases germination chances. The rollers are used post-seeding to press seed firmly into contact with the soil for improved germination rates; the trap wire mesh also creates a pattern of uniformly spaced mini-furrows that help retain essential moisture and resist erosion from wind, rain, and irrigation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff farmers and researchers
Approaches to be used in dissemination	• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Efficiency and low cost
Partners/stakeholders for scaling up and their roles	• KALRO, Universities (for information) • Machinery fabricators • NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Lack of the equipment • Lack of facilitation to demonstration site • High initial cost for small-scale equipment

Suggestions for addressing the challenges	• 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	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 30,000
Estimated returns	KES 20,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Teff roller is expensive for women and youth to afford • Women and youth have limited finances to pay services and to purchase farm equipment such as Teff roller due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization including teff roller. • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • Teff roller binder should be designed for easy start and operation. • Up-scaling should target all the gender and they should be affordable to all gender
Gender related opportunities	• High productivity increasing food security and nutrition for women and youth • Creates employment especially for youth • Reduces drudgery for all gender farmers in land preparation for teff planting
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as teff roller due to limited access to credit facilities • Operating a teff roller is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to buy teff roller since it is affordable and easy to maintain • Teff roller need to be designed in such a way which would enable people able differently to operate • In addition they should to be affordable

VMG related opportunities	• High productivity increasing food security and nutrition for VMGs • Creates employment especially for VMGs • Makes land preparation for teff easy for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.7. TIMP Name	**Motorized Sprayer**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	13 Slow and tedious processes of manual spraying of Teff 14
What is it? (TIMP description)   Source: https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.potatogrower.com%2F2018%2F06%2Fselectingtherightnozzlesfor&psig=AOvVaw1RLnP6wDs0LYeXeTntqxRa&ust=1666166140639000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCIjk_tmm6foCFQAAAAAdAAAAABAG)	A motorized **sprayer** is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers are man-portable units typically backpacks with spray guns They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron e.g. as well as foliar fertilizers.

Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before teff forms a canopy, broad leafed weeds compete with teff seedling for nutrients and light greatly reducing their yield. Manual sprayer are labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Teff Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development dissemination, adoption and scaling up dissemination	• Motorized sprayer is designed for easy start and operation hence it is gender friendly and can be used by women also • Women and youth have limited finances to pay services and to purchase a motorized sprayer for use in the teff farms due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to so they might not be aware of the of motorized sprayer • Men dominate most decisions at the household and community levels hence determines the type of farm

	equipment and machines to be used in teff farms facilities to be used in farms • Men have been drawn to spraying by the machine. • This task was predominantly for women before the introduction of the machine.
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men • It promote gender inclusivity reducing the work load for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase motorized sprayer due to limited access to credit facilities • Operating a motorized sprayer is complex for some VMGs especially those who are abled differently • Teff motorized sprayer need to be designed in such a way which would enable people able differently to operate
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.8. TIMP Name	**Reaper Binder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of Manual threshing and winnowing of Teff Quality of grain
What is it? (TIMP description)  (Source:https://3.imimg.com/data3/FY/WG/GLADMIN-78065/reaper-binder-500x500.jpg)	The reaper-binder, or binder, is a farm implement that improved upon the simple reaper. In addition to cutting the small-grain crop, a binder also 'binds' the stems into bundles or sheaves. These sheaves are usually then 'shocked' into A-shaped conical stooks, resembling small tipis, to allow the grain to dry for several days before being picked up and threshed.
Justification	• It takes too much time and labour to sickle teff • Working in teff fields is difficult during rainy seasons • Manual labour has become expensive • The machine is versatile and affordable
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Use by Farmers
Partners/stakeholders for scaling up and their roles	• Machinery fabricators • NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.

Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	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	• Teff reaper binder is expensive for women to afford • Women and youth have limited finances to pay services and to purchase farm equipment such as Teff reaper binder due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization including Teff reaper binder • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • Teff reaper binder should be designed for easy start and operation. • Up-scaling should target all the gender and they should be affordable to all gender
Gender related opportunities	• High productivity increasing food security and nutrition for women and youth • Creates employment especially for youth • Reduces drudgery for all gender farmers in reaping teff
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment such as teff reaper binder due to limited access to credit facilities • Operating a teff reaper binder is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to buy teff reaper binder since it is affordable and easy to maintain • Teff reaper binder machines need to be designed in such a way which would enable people able differently to operate • In addition they should to be affordable
VMG related opportunities	• High productivity increasing food security and nutrition for VMGs • Creates employment especially for VMGs • Makes teff reaping work easy for perform for VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe, W. W.
Partner organizations	Local Fabricators

2.10.9.TIMP Name	**Thresher**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Threshing teff is a laborious activity that is left to women • Threshing is followed by cleaning • Most post-harvest losses occur during threshing • Manually threshed teff has debris • The process is time wasting • Labour costs are high

What is it? (TIMP description)  (Source: Nasirembe, KALRO Katumani)	A threshing machine or a thresher is a piece of farm equipment that threshes grain, that is, it removes the seeds from the stalks and husks. It does so by beating the plant to make the seeds fall out. It separate stalk from grain and winnows to remove fine particulates
Justification	To make Teff threshing and winnowing faster, less tedious and more effective. Attract the youth to agribusiness through operation of the machines. Hand threshing and separation is tedious and time consuming while transporting before threshing is costly and causes loss of grains
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Teff Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	• Use by Farmers
Partners/stakeholders for scaling up and their roles	• Machinery fabricators • NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Marsabit
Counties where TIMP will be up scaled	Marsabit, Makueni, Mandera, Isiolo, Machakos
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership

	• Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Teff thresher 125,000 KES per unit
Estimated returns	Capacity 500 Kg/ hour, Fuel 1 litre /hr (4-5 bags) Needs 2 operators per time Threshing charges: KES 300 per bag Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development, dissemination, adoption and scaling up	• Thresher is expensive for women to afford • Women and youth have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Women have limited access to education, training and extension services than men relating to farm mechanization • Men dominate most decisions at the household and community levels hence determines the type of facilities to be used in farms • Threshers should be designed for easy start and operation. • Up-scaling should target all the gender and they should be affordable to all gender
Gender related opportunities	• High productivity increasing food security and nutrition for women and youth • Creates employment especially for youth • Reduces drudgery for all gender farmers in threshing teff
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited finances to pay services and to purchase farm equipment due to limited access to credit facilities • Operating a threshing machine is complicated for some VMGs especially those who are abled differently to operate • VMGs need to be equipped with information relating to the TIMP • Linking the VMG to financial institutions would enable them to buy since it is affordable and easy to maintain machines • Farm machines need to be designed in such a way which would enable people able differently to operate • In addition they need to be affordable
VMG related opportunities	• High productivity increasing food security and nutrition for VMGs • Creates employment especially for VMGs • Makes threshing easy to perform for VMGs

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

2.11. TEFF FARMING BUSINESS AND MARKETING PRACTICES

2.11.1 TIMP Name	**Transformative Model of production of Teff**
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity (0.3 tons per hectare) due to farmers' non-transformation from subsistence-oriented production to commercial-oriented production. The smallholders farmers mainly produce Teff for the subsistence and therefore lack of productivity increase objective
What is it? (TIMP description)	The transformative model builds resiliency of farmers of Teff to focus on market orientation. The transformation model aims at a shift 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	Transformative model ensures increase in productivity due to the surplus demand. Without transformation of Teff production, the crop will remain subsistence and commercialization will not be attainable, leading to the decline in production and income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Small scale farmers • Small-scale processors • Teff exporters • Food processors • Local traders • Consumers • Input markets due to demand in improved markets
Approaches to be used in dissemination	• ToT • Field days • Exhibitions • Agricultural shows • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Availability of high yielding seeds • Availability of markets • Acceptability of Teff in the farming systems • Transformative ability of farmers

	• Favourable policy for trade in Teff
Partners/stakeholders for scaling up and their roles	• MoALFC: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • Processors: To process high quality Teff products • Supermarkets to accept and stock product for sale • Consumers: Acceptability • Marketers: Moving Teff products from processors to consumers
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit
Counties where TIMP will be Upscalled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka-Nithi, Kitui (Mwingi area), Makueni
Challenges in dissemination	• Awareness: Limited awareness of the economic potential by farmers and consumers • Stakeholder linkages: Stakeholders for enhancing transformation • High intensity of Teff management; both in the field and post-harvest
Suggestions for addressing the challenges	• Awareness creation about the potential of Teff production to farmers, consumers and other value chain actors • Information dissemination – postharvest handling, value addition, and nutritional attributes of the product • Scaling up participation of end-user in technology development such as demonstrations and training activities • Promote Teff production all year round
Lessons learned in upscaling, if any	• Resistance of farmers in growing Teff • Subsistence levels of Teff production • Variability in Teff demand • Fluctuations in prices
Social, environmental, policy and market conditions necessary) for development and upscaling	• Farmers' perceptions • Increase in drought frequency • Supportive policy in place • Organized markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development, dissemination and related opportunities	• Women are usually left out when teff and agricultural marketing groups and innovation platforms are being formed due to their social economic status in the society • Women do not have time to attend organized meetings due to their busy schedules

	• Women might not be aware of the existing agricultural marketing groups due to limited access to agricultural information and extension services • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender opportunities	• Increased profitability • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development, dissemination and opportunities	• Due to their social status VMGs are often excluded from joining potato marketing groups • VMGs might not be aware of existing teff marketing groups and innovation platforms • VMGs are excluded when important decision are being made relating to teff production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMGs opportunities	• Increased profit for VMGs • Improved access to market within and without by VMGs • Increased access to market information and channels by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Teff revolution in Kitui County
Application guidelines for users	• Factsheets • Teff production guidelines
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600

Lead organization and scientists	KALRO Rachael Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps *Further research*

1. Efficiency evaluation of the farmer-market linking models
2. Equity distribution among the producers
3. Productivity levels among the smallholder farmers due to transformation
4. Farmers access to production inputs

2.11.2 TIMP name	**Building a Business Plan for Teff production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to unplanned and traditional production, leading to lack of production targets, losses and market failure
What is it? (TIMP description)	A Teff business plan serves as an internal management and organizing tool, used to communicate outside the business, or both. The document contains the elements of marketing strategy, marketing costs, income streams and financial requirements
Justification	With a business plan in hand, Teff farmers and rural entrepreneurs will be able to take that first step toward the creation of a successful and sustainable business. The plan enables farmers to control costs, develop marketing strategies and build plans for the production to meet market demand
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Small scale farmers • Small-scale processors • Food processors • Local grain traders • Grain exporters
Approaches to be used in dissemination	• ToT • Farmers' groups • Farmers' Trainings
Critical/essential factors for successful promotion	• Availability of Teff grains • Availability of farmers' groups • Accessed markets • Available technologies for increasing productivity

Partners/stakeholders for scaling up and their roles	• MoALFC: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • KEBS: certification • Processors: To process high quality Teff products • Supermarkets to accept and stock product for sale • Consumers: Acceptability • Marketers: Moving Teff products from processors to consumers
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit
Counties where TIMP will be Upscalled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka Nithi, Kitui (Mwingi area), Makueni
Challenges in dissemination	• Literacy levels of farmers • Availability of farm records • Levels of skills in market information collection
Suggestions for addressing the challenges	• Capacity building in business plan development • Training of ToTs
Lessons learned in upscaling, if any	• None
Social, environmental, policy and market conditions necessary) for development and upscaling	• Existence of farmers' groups • Suitable environment for Teff production • Supportive policy in place • Improved access to markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development, dissemination and related opportunities	• Women are usually left out when teff marketing groups and innovation platforms are being formed due to their social economic status in the society • Teff stakeholders do not have business plan especially women due to illiteracy and limited knowledge on how it is done • Women do not have time to attend organized agricultural meetings due to their busy schedules • Women might not be aware of the existing teff marketing groups where they can share new information relating to markets and prices of teff products • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities

	• In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
VMG issues and concerns in development, dissemination and opportunities	• Adopting the TIMP will enable women and youth to have good management of their teff bussines • Women and youth will be able to improved prices from teff products increasing their livelihoods • There is potential of increasing women and youth employment along the teff value chain • Increased opportunities market opportunities for women and youth to sell teff products • Increasing important information relating to production and marketing of teff products for women and youth • Improved livelihood for women and their families • Improved food security and nutrition for women and youth
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Business plan has been succesiful with other crops and can be similary applies to teff
Application guidelines for users	• Factsheets • Business plan guidelines
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

2.11.3 TIMP name	Contracted Teff production model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to market failure in coordinating Teff production, leading to low income 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Small scale farmers • Contractors
Approaches to be used in dissemination	• ToT • Field days • Exhibitions • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Availability of contractors • Willing producers • Availability of quality standards and assured markets

	• Favorable policy to promote contract farming
Partners/stakeholders for scaling up and their roles	• MoALFC: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • KEBS: certification • Contractors
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit
Counties where TIMP will be Upscalled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in dissemination	• Contractors: Availability of contractors • Awareness: Limited awareness on contracted production by the smallholder farmers • Breaking the agreement
Suggestions for addressing the challenges	• Linking farmers to contractors • Awareness creation about the contracted production • Enforcement of agreement
Lessons learned in upscaling, if any	• Contracted farmers earn higher income • Contracted production arrangement enable farmers to access improved inputs • Contracted production has linked markets
Social, environmental, policy and market conditions necessary) for development and upscaling	• Acceptability by farmers on contracted production • Supportive policy in place • Ability to meet quality agreed
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development, dissemination and related opportunities	• Women might not be aware of contracted Teff production model due to limited agricultural marketing information and extension services • Most of teff farmers might not have adequate knowldge on contracted Teff production model due to illiteracy and limited trainings • Developed dissemination materials giving details of the TIMP are usually written in a language which teff stakeholders do not understand especially women due to illiteracy • Women are usually left out when teff marketing groups and innovation platforms are being formed due to their social economic status in the society

	• Women do not have time to attend organized agricultural meetings due to their busy schedules • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
VMG issues and concerns in development, dissemination and opportunities	• Adopting the TIMP will enable women and youth to have good management of their teff bussines • Adopting the TIMP will lead to improved teff prices for all genders • There will be reduced exploitation of women by the middle men • There will be increased ready teff markets for teff producers • Improved livelihood for women and their families
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• The succicessiful contracted sorghum production in lower eastern, upper eastern and western Kenya can also be applied succesifully for teff
Application guidelines for users	• Contract farming factsheets • Agreement guidelines
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

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

2.11.4 TIMP name	Collective marketing
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to the smallholder farmers' uncoordinated production and marketing of Teff, leading to market inaccessibility. The individual farmer marketing, leads to low market power and therefore lack of money to buy improved inputs for production
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. Collective marketing is carried through Producer Organizations' (POs) is an institutional vehicle for promoting agricultural production by helping farmers solve common problems in relation to production inputs, credit, technical knowledge and marketing of the produce
Justification	Due to small-scale farming of Teff, 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. The smallholder farmers of Teff do marketing individually. Due to that, there is lack of economic scale and the prices offered are low. The formation of producer organizations assists small-scale farmers in aggregating the Teff produce to form a large scale and gain bargaining power for higher prices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Small scale farmers • Teff grain traders
Approaches to be used in dissemination	• ToT • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	• Willing producers • Availability of quality standards and assured markets • Favorable policy to promote formation of collective marketing
Partners/stakeholders for scaling up and their roles	• MoALFI: Mobilization and training • NGOs / CBOs: -Mobilization and training • Cooperatives: Registration and training
C: Current situation and future scaling up	
Counties where already promoted, if any	Marsabit

Counties where TIMP will be Upscalled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in dissemination	• Formation of marketing groups • Awareness: Limited awareness on the collective marketing • Formation of the governing institutions • Distribution of incentives • High costs of group operations • Group dynamics
Suggestions for addressing the challenges	• Awareness on the importance of collective marketing • Training of group dynamics • Information dissemination – postharvest handling, value addition, and nutritional attributes of the product
Lessons learned in upscaling, if any	• Collective marketing increases income for the individual farmers • Collective marketing links farmers to buyers
Social, environmental, policy and market conditions necessary) for development and upscaling	• Farmers with common interests in Teff production and marketing • Suitable environment for the Teff production • Supportive policy in place • Ability to meet the required market quality standards
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development, dissemination and related opportunities	• Women might not be aware of teff collective marketing model due to limited agricultural marketing information and extension services • Most of teff farmers might not have adequate knowldge on collective marketing model due to illiteracy and limited trainings • Developed dissemination materials giving details of the TIMP are usually written in a language which teff stakeholders do not understand especially women due to illiteracy • Women are usually left out when teff marketing groups and innovation platforms are being formed due to their social status in the community • Women do not have time to attend organized agricultural meetings due to their busy schedules • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation

VMG issues and concerns in development, dissemination and opportunities	• Adopting the TIMP will enable women and youth to have good management of their teff bussines • Adopting the TIMP will lead to improved teff prices for all genders • There will be reduced exploitation of women by the middle men • There will be increased ready markets for teff producers • Improved livelihood for women and their families
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• The succicesiful sorghum collective marketing for the East African Breweries Limited in lower eastern, upper eastern and western Kenya can also be applied succesifully for teff
Application guidelines for users	• Collective marketing manual • Agro-enterprise development guidelines
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

- **Research Gaps**

1 Profitable opportunities
2 Performance of marketing as a group

2.11.5. TIMP Name	**Profitability analysis**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to low farmers' income. The problem of failure of profitability analysis is common among the smallholder farmers. Lack of profitability analysis by farmers in Teff 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 Teff agro-enterprise
Justification	Profitability analysis reviews the management success and sustainability of the Teff business. It indicates areas of adjustment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	• Trainings • Factsheets • Manuals • 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 Teff varieties • A platform for interaction in Teff 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
C: Current situation and future scaling up	
Counties where already promoted if any	Marsabit
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination -	• Inability of farmers to keep records • Use of non-costed family labour in Teff production
Suggestions for addressing the challenges	• Inability of farmers to keep records – capacity building • Use of non-costed family labour in Teff production – capacity building on how to cost family labour
Lessons learned in up scaling if any	• Farmers will appreciate profitability analysis in the case of increased returns
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 Teff • Policy conditions – Policy support in costs of inputs and prices of outputs • Market conditions – Higher prices than costs
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development and dissemination, adoption and scaling	• Women engaging in teff value chain have not been to make profits from the sale of their produce due to limited knowledge in profit analysis. • Women are associated with poor performance within teff value chain has been attributed to their lack of comparison of costs and returns • Most women farmers especially those involved in teff production are semi-illiterate hence they are not able keep records on teff production costs and on their sales to monitor the performance of their value chain • Women and youth have limited access to agricultural information and extension especially relating to marketing of teff • Women do not have time to attend organized meetings due to their busy schedules limiting them the opportunity to share and learn from other teff farmers • Women and youth have limited finances to pay for services such as training unlike men due to limited access to credit facilities •
Gender related opportunities	• There will be increased markets local and distance increasing incomes for women and youth • Women and youth will be equipped with skills which will enable them to monitor the performance of teff • There will be increase employment for women and youth at various nodes of teff value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have limited information on marketing hence being exploited by middle men • The VMGs do not have access to external markets • The VMGs have limited finances which limits them from paying for services such as trainings • VMGs have limited access to agricultural information and extension especially relating to marketing of teff • VMGs are usually left out when key decisions are being made relating to the teff value chain • VMGs have limited finances to pay services such as training due to limited access to credit facilities • VMG farmers especially those involved in teff production are semi-illiterate hence they would not be able to keep records on the costs incurred in teff production and finances acquired after the sale of pigeon pea and products
VMG related opportunities	• There will be increased teff in the markets for VMGs • There will be increase employment for VMGs at various nodes of teff value chain • Improve livelihoods for the VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Commercialization model of sorghum in Machakos, Kitui and Tharaka-Nithi Counties through EABL market outlet can also be a success story on teff
Application guidelines for users	• Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

- **Research Gaps**
  1. Investigation on strategies to reduce costs of production of Teff
  2. Investigation on price increasing strategies

2.11.6. TIMP Name	Market research for Teff farmers
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to lack of market information. Failure of the smallholder farmers in gathering information on markets, leads 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 buyers, 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: Assessment of dissemination and scaling up/out approaches	
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 • How will the farmers increase their production and sales (more technology, more land, more members) • Can the farmers work with other existing groups (available/not available) • Do the farmers need to form new groups • Applied and adaptive Research to test, validate and release improved Teff varieties • A platform for interaction in Teff value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Members of producer organization • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Marsabit
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka Nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination -	• Issues related to the literacy of the marketing groups • Issues related to the mobilization and creation of awareness • Levels of skills of the market research group • Existence of market information
Suggestions for addressing the challenges	• Issues related to increasing production from existing group – Capacity building of farmers • Issues related to mobilization and awareness creation – sensitization of farmers • Market research skills – Training • Market information – Record keeping
Lessons learned in up scaling if any	• Increased access to market information • Increased Teff productivity
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – are there other farmers who want to join the group • Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group

	• Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – new markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development and dissemination, adoption and scaling	• Teff stakeholders might not be aware of market research and its importance due to illiteracy • Teff stakeholders and especially women they lack adequate information regarding teff markets outlets and their demands as a result they are exploited by middle men because they sell teff products locally • Women and youth are left out during the formation of agricultural marketing groups and innovation platforms due to lack of exposure • Women have limited access to education, training and extension services than men so they might not be aware of the existence of marketing groups
Gender related opportunities	• Awareness will be created relating to the existing market out lets for teff • There is potential of improving livelihoods for women • There will be increased employment for women and youth at various nodes of teff value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are usually left out during the formation of pigeon pea marketing groups hence they do not get new information relating to the value chain • VMGs have limited information on marketing hence being exploited by middle men • The VMGs do not have access to external markets since they have limited information on existing distance markets • The VMGs have limited finances which limits them from paying of services such as trainings • VMG farmers especially those involved in teff production are semi-illiterate hence they might not be aware of market research and its benefits
VMG related opportunities	• Increased production and sales of teff by VMGs. • Increased market outlets for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-

Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

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

2.11.7. TIMP Name	**Marketing innovation model**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to the farmers' failure to apply entrepreneurship in the production and marketing of Teff which also lead 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 Teff, the market outlook will be narrow
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension • NGOs • Researchers
Approaches to be used in dissemination	• Trainings • Factsheets • Manuals • 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 Teff varieties • A platform for interaction in Teff 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
C: Current situation and future scaling up	
Counties where already promoted if any	Marsabit
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination	• Small-scale farming • Availability of information • Profitability in Teff 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 – sustainability of innovations • Market conditions – Access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development and dissemination, adoption and scaling	• Teff stakeholders might not be aware of the Marketing Innovation model and its importance due to illiteracy • Teff stakeholders and especially women they lack adequate information regarding teff markets outlets and their demands as a result they are exploited by middle men because they sell teff products locally • Women and youth are left out during the formation of agricultural marketing groups and innovation platforms

	due to lack of exposure • Women have limited access to education, training and extension services than men so they might not be aware of the existence of marketing groups • Women do not have time to attend organized meetings due to their busy schedules • Women might not be aware of the existing teff marketing groups • Women and youth have limited finances to pay services such as training unlike men due to limited access to credit facilities • In some cultures, women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	• Increased production and sales of teff by youth, females and males. • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGS might not be aware of the Marketing Innovation model and its importance due to illiteracy • VMGs lack adequate information regarding teff markets outlets and their demands as a result they are exploited by middle men because they sell teff products locally • • Due to their social status VMGs are often excluded from joining teff marketing groups • VMGs might not be aware of existing teff marketing groups and innovation platforms • VMGs are excluded when important decision making are being made relating to teff production and marketing • VMGs also have limited participation and influence in rural producer organizations due to limited access to assets, resources and services, required for members to join
VMG related opportunities	• Increased profit for VMGs • Improved access to market within and without by VMGs • Increased access to market information and channels by VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Available innovations are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

1 Sustainability based on market prices
2 Innovations for the increased productivity

2.11.8. TIMP Name	**Digital marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to the market inaccessibility among the smallholder farmers. The smallholder farmers have 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 online marketplace that provides buyers and sellers with an avenue to meet and exchange goods and services 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: Assessment of dissemination and scaling up/out approaches	
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 Teff production and profitability analysis • Levels of experiences in Teff production • Availability of information on Teff production and marketing • Applied and adaptive Research to test, validate and release improved Teff varieties • A platform for interaction in Teff value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of Teff production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of Teff • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the Teff 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 Teff production and marketing and profitability - Developing information hubs

	• Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	• Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – low levels of adoption of information technology • Environmental conditions – improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/A
Estimated returns	N/A
Gender issues and concerns in development and dissemination, adoption and scaling	• Teff stakeholders might not be aware of the TIMP especially women due to illiteracy • Most women have limited information on how they can use internets to market their teff products • In the region where teff is grown internet services might not be available when needed • Women are usually poor and they lack access to modern mobile devices due to limited finances to buy mobile phones and airtime • There is inadequate information on the teff production and marketing and profitability for women in the internet • Women and youth have limited finances to pay services unlike men due to limited access to credit facilities • Women have limited access to education, training and extension services than men • Some of the teff farmers especially women are semi-illiterate hence might not be able to understand the information acquired through the social media since it is usually in English or Swahili
Gender related opportunities	• Improved accessibility of information due to availability of mobile phones by youth, males and females • Job creation for youth in availing information and in selling mobile phones • If adopted there will be increased teff markets local and distance for women and the youth • There will be improved production of teff for women hence increased livelihoods

	• There will be improved food security and nutrition for women
VMG issues and concerns in development and dissemination, adoption and scaling up	• Teff stakeholders might not be aware of the TIMP especially the VMGs due to illiteracy • Most VMGs have limited knowledge on the use of internets to market their teff products • VMGs are usually poor and they lack access to modern mobile devices • There is inadequate information on the teff production and marketing and profitability for VMGs • VMGs have limited finances to pay services due to limited access to credit facilities • VMGs have limited access to education, training and extension services. • VMGs are semi- illiterate hence might not be able to understand the information acquired through the social media since it is usually in English or Swahili
VMG related opportunities	• Improved accessibility of information due to availability of mobile phones by VMGs • Job creation for VMGs in availing information and in selling mobile phones • If adopted there will be increased pigeon pea markets for VMGs both local and distance • There will be improved production of pigeon peas by VMGs leading to improved livelihoods • There will be improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Digital Marketing has been helpful to farmers to reach out the multiple buyers and get higher prices for their products. It empowers agricultural startups. Young farmers are ready to adopt Digital marketing platforms including in teff.
Application guidelines for users	• Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
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Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

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

2.12. AGRICULTURAL POLICY OPTIONS

2.12.1. TIMP Name	National agricultural policy strategy framework
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to limited policy support in inputs and outputs markets. The smallholder farmers are inaccessible to inputs and outputs markets. The instruments and the rules to achieve the policy productivity objectives are inappropriate for the smallholder farmers of Teff production but instead favour the large scale farmers in Kenya. Moreover, the smallholder farmers of Teff are not aware of the instruments and rules for achieving productivity objectives
What is it? (TIMP description)	The National Agricultural policy strategy framework provides instruments and rules for the smallholder farmers to increase Teff productivity in the Counties.
Justification	Without the National Agricultural policy strategy framework, agriculture will remain not integrated with the National development objectives. There will be lack of instruments and the rules to achieve agricultural productivity objectives.
B: Assessment of dissemination and scaling up/out approaches	
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 Teff-based policies • Applied and adaptive Research to test, validate and release improved Teff varieties • A platform for interaction in Teff value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Teff policies to support production and marketing • County extension staff - Sensitization of farmers

	• NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Teff policies to support production and marketing • Research institutions – Sensitization of stakeholders • Policy makers – Assist in policy making
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination	• **Value Chain**: Teff yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • **Aggregation**: Aggregation models including cooperatives—suffered after the downturn in Teff production, wherein many farmers abandoned Teff production. These weak organizations provide few services to farmers while providing limited bargaining power. • **Financial Incentives**: The government provides only limited support to Teff producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs). Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.
Suggestions for addressing the challenges	**Value Chain:** Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors. Standards: Existing Teff standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training. **Aggregation:** Partnerships between farmer cooperatives and Teff producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs. **Financial Incentives**: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based

	Teff payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	When policy instruments and rules are well implemented, there woul be an increase in productivity of Teff
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptability of the policy instruments and rules by the smallholder farmers of Teff • Environmental conditions – sustainability in Teff production • Policy conditions – Lacking specific Teff policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	• Most of the teff farmers have limited information on the existing agricultural policies especially relating to teff production due to limited access to agricultural information and extension services • Most teff farmers especially women are not aware of the importance of agricultural policies and might think they are oppressive and not working for their good • Teff farmers are unable to access production inputs such as certified teff seeds, fertilizer and agro –chemicals • In marketing of teff women and youth face exploitation from middle men because there are not aware of the policies guiding production and marketing of the value chain • Women are usually left out when key decisions are being made relating to teff value chain • Women and youth lack Access and control of productive resources such as land, equipment and credit facilities • Policies relating to teff value chain should support youth, females and males in production and marketing of teff
Gender related opportunities	• Increased income for youth female and male • Increased employment for youth, females and males • There will be improved policy relating to certified seeds for women since they are the majority within the pigeon pear value chain • There will be policies working for the benefit of farmers and not against
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have no access to certified inputs such as seeds of VMGs • VMGs are left out when key decisions are being made relating to teff production and marketing

	• In marketing of teff VMGs are exploited by middle men because there are not aware of the policies guiding production and marketing of the value chain • VMGs have limited information on the existing agricultural policies especially relating to teff production due to limited access to agricultural information and extension services • Most teff farmers especially VMGs are not aware of the importance of agricultural policies and might think they are oppressive and not working for their good • Teff farmers are unable to access production inputs such as certified teff seeds, fertilizer and agro –chemicals
VMG related opportunities	• Supporting VMGs in the production and marketing of teff. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
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Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

1 Adoption of policies
2 Equity distribution among the stakeholders
3 Productivity levels among the smallholder farmers of Teff
4 Farmer accessibility to production inputs
5 Impact on Teff prices

2.12. 2.TIMP Name	**Participation in County Integrated Development Planning**
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to limited participation of the smallholder farmers of Teff during County development planning. Based on that, there is lack of County integration of Teff production and marketing during planning.
What is it? (TIMP description)	The County Integrated Development Planning 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 Teff production, marketing and processing are considered. .
Justification	In the Counties where the Teff value chain creates wealth among the smallholder farmers, centralization of the farmers agency and voices during the County Integrated Developing Planning is need.. Failure to plan for the Teff production would to less optimization of opportunities
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Traders • Processing industries • Extension • NGOs • Research institutions • Policy makers
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 agricultural policies and specific Teff-based policies • Issues in Teff business • Specific policy objective statement • Applied and adaptive Research to test, validate and release improved Teff varieties • A platform for interaction in Teff value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Teff policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers

	• Private sector (local traders and exporters) – Demanding Teff policies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Marsabit
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka Nithi, Kitui (Mwingi area), Makueni
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 Teff value chain • Teff production are specific to agro-ecological zones and not all the Counties in Kenya grow Teff
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Teff value chain – strengthening Teff value chain • Teff production are specific to agro-ecological zones and not all the Counties in Kenya grow Teff – Diversification of Teff
Lessons learned in up scaling if any	• There is increase in Teff productivity • There is Teff business in the Counties which recognize the potential of Teff during the County Integrated Development Planning
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptability and contribution during the policy making process • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Teff policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	• Women might not have adequate information on the CIDP due to their low level of education • Women may not be able to travel away from their homes to producer group meetings, without permission limiting them chance of getting information

	• Women and youth are discriminated against when important decisions are being held relating to development at all levels • Women may not be able to travel away from their homes to attend trainings meetings, without permission so they are not able to participate in policy stakeholders meetings relating to agricultural production • Women are limited from participating in agricultural meetings as they lack finances to pay for transport if the meetings are held far from their localities • In marketing of teff women and youth face exploitation from middle men because they are not aware of the policies guiding its production and marketing of the products at the county level • Women are usually left out when key decisions are made relating starting from the household to the County level • Women and youth lack access and control of productive resources such as land, equipment and credit facilities • The county need to encourage inclusion of all members of the community including: the poor, men, women, physically challenged, youth, vulnerable and marginalized groups
Gender related opportunities	• Supporting youth, females and males in the production and marketing of teff. • Increased income by youth female and male • Increased employment by youth, females and males • There will be increased participation of all genders in teff production and marketing • Increased income by youth female and male • Increased employment for all genders at various nodes of teff value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are left out when key decisions are being made relating to production and marketing • VMGs are not aware of existing agricultural policies especially relating to teff value chain due to limited access to agricultural information and extension • VMGs are excluded from participating when important meetings and workshops are being held relating to agricultural information and dissemination • VMGs may not be able to travel away from their homes to attend trainings meetings, due to their physical challenges and also lack of finances to pay for their transport

	• VMGs have less access to agricultural information, technology and knowledge
VMG related opportunities	• There will be increased support of the VMGs in the production and marketing of teff. • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Promotion of Teff through County policies
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

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

2.12.3.TIMP Name	Policy instruments related to Teff
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to the existing policy instruments which fail to support the smallholder farmers' issues in Teff production and marketing. Therefore, weak policy instruments have led to the market failure for both inputs and outputs

What is it? (TIMP description)	The policy instruments are the means to achieve policy objectives. For the Teff production, some of the policy instruments include subsidy in the inputs and also minimum price for the Teff outputs.
Justification	Without policy instruments the Teff productivity will remain low. 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 Teff production
B: Assessment of dissemination and scaling up/out approaches	
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 Teff varieties • A platform for interaction in Teff 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
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka-Nithi, Kitui (Mwingi area), Makueni
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 Teff value chain • Teff production are specific to agro-ecological zones and not all the Counties in Kenya grow Teff
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Teff value chain – strengthening Teff value chain • Teff production are specific to agro-ecological zones and not all the Counties in Kenya grow Teff – Diversification of Teff
Lessons learned in up scaling if any	• In the Counties where Teff production is supported through the policy, there is productivity increase
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 Teff policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	• Teff stakeholders are not aware of the existing policies due to illiteracy and limited access to agricultural information and extension services especially women • There has been inadequate information to stakeholders on the agricultural policies whether National or County at the County level leading to exploitation of farmers by middle men • Women and youth are discriminated against when important decisions are being held relating to development at all levels • Women may not be able to travel away from their homes to attend trainings meetings, without permission so they are not able to participate in policy stakeholders meetings relating to agricultural production • Women are limited from participating in agricultural meetings as they lack finances to pay for transport if the meetings are held far from their localities • Women and youth lack access and control of productive resources such as land, equipment and credit facilities
Gender related opportunities	• There will be increased production of teff by youth, females and males. • Increased resource use in agricultural production and processing by youth, women and men

	• Women and youth will be able to get information relating to subsidized inputs for teff production increasing their yields leading to increased incomes • There will be stable teff production by women and the youth
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are not aware of the existing policies due to illiteracy and limited access to agricultural information and extension services • There has been inadequate information to stakeholders on the agricultural policies whether National or County at the County level leading to exploitation of farmers by middle men • VMGs are excluded from participating when important meetings and workshops are being held relating to agricultural information and dissemination • VMGs may not be able to travel away from their homes to attend trainings meetings, due to their physical challenges and also lack of finances to pay for their transport
VMG related opportunities	• Efficiency and access to resources and input required to increased teff productivity for VMGs • Reduced exploitation of VMGs by middle men • Increased income for VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Wealth creation in Teff production
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
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Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

1 Validation of policy instruments

5 Equity distribution among the stakeholders
6 Farmer accessibility to production inputs markets
7 Farmers accessibility to output markets

2.12.4. TIMP Name	Policy cycle
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Teff productivity due to the development of agricultural policies not relevant to the problem emergency in Teff 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 provide a frame work and antedates any forthcoming issues related to policy development. The policy *cycle* 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 Teff? 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Traders • Processing industries • Extension • NGOs • Research institutions
Approaches to be used in dissemination	• Meetings • Radio

	• 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 stakeholders • The stages of problem emergence, formulation, implementation and evaluation • Applied and adaptive Research to test, validate and release improved Teff varieties • A platform for interaction in Teff value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – generate issues • County extension staff - capacity building • NGOs – capacity building • Private sector (local traders and exporters) – generate issues • Research institutions – capacity building • Policy makers
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Mandera, Marsabit, Isiolo, Wajir, Garissa, Tana-river, Tharaka=nithi, Kitui (Mwingi area), Makueni
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on issues • Poorly established Teff 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 Teff value chain – strengthening Teff 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 Teff producers • Environmental conditions – environmental issues concerning sustainability in Teff production • Policy conditions – Lacking specific Teff policy • Market conditions – Market issues
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established

Estimated returns	To be established
Gender issues and concerns in development and dissemination, adoption and scaling	• Women and youth have limited access to education, training and extension services than men • Women may not be able to travel away from their homes to attend trainings meetings, without permission so they are not able to participate in policy stakeholders meetings relating to agricultural production • Women are limited from participating in agricultural meetings as they lack finances to pay for transport if the meetings are held far from their localities • Women have less access to agricultural information, technology and knowledge • Teff farmers especially women are unable to access production inputs such as certified teff seeds, fertilizes and agro –chemicals • Women are usually left out when key decisions are made relating to pigeon pea value chain • Women and youth lack access and control of productive resources such as land, equipment and credit facilities • Policies relating to teff value chain should support youth, females and males in production and marketing of teff
Gender related opportunities	• There will be increased participation of all genders in teff production and marketing • Increased income by youth female and male • Increased employment for all genders at various nodes of teff value chain
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have no access to certified inputs such as seeds • VMGs are left out when key decisions are being made relating to pigeon peas production and marketing • VMGs are not aware of existing agricultural policies especially relating to teff value chain due to limited access to agricultural information and extension services • VMGs are not able to read document written on agricultural policy due to their low education and isolation when important agricultural dissemination meetings are held.
VMG related opportunities	• Reduction of VMGs problems in the production and marketing of teff products. • Involvement of VMGs in the implementation of policy • There will be increased support of the VMGs in the production and marketing of teff. • Increased income by VMGs

	• Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI-Katumani P.O. Box 340, 90100 Machakos Email: director.amri@gmail.com Phone: 0710906600
Lead organization and scientists	KALRO; Racheal Kisilu; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Research Gaps

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

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