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Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

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

Pole F.N., Gathambiri C., Kori J., Ambuko J., Kasina M.J., Otipa M., Wayua F., Wambua J., Mutisya D., Thuranira M., Ndambuki J., Wasike V.W., Nasirembe W., Mwangi H.W., Momanyi V.N., Ndung'u J., Esilaba A.O., Lung'aho C., Kamau G.M., Nyabundi K.W., Ouda J.O., Kirigua V.O. and Wasilwa L.A.

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DISCLAIMER

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

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

Compiled by: Pole F.N., Gathambiri C., Kori J., Ambuko J., Kasina M.J., Otipa M., Wayua F., Wambua J., Mutisya D., Thuranira M., Ndambuki, J., Wasike V.W., Nasirembe W.W., Mwangi H.W., Momanyi V.N., Ndung'u J., Esilaba A.O., Lung'aho C., Kamau G.M., Nyabundi K.W., Ouda J.O., Kagunyu A.,Too A.K., Kirigua V.O. and Wasilwa L.A.

Editors: Nyabundi K.W., Ouda J.O., Kinyua Z., Maritim T.K, Mukundi K.T. and Kedemi R.M.

Editing and Publication Coordination: Kirigua V.O., Nyambati E.M. and Lung'aho C.

Design and layout: Nyaola E.

Formating and Typesetting: Maweu, N.M.

FOREWORD

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

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

Extensive information from research and background data has been used to develop this revised Inventory of TIMPs for the Cashew Value chain. To disseminate the TIMPs, a Training of Trainers (ToT) manual has been developed. The design of the manual takes into consideration the delivery system, partners and their roles, duration of training and logical flow of the modules. The training modules have a uniform outline that ensures every aspect of the TIMPs are fully covered in way that the trainees can absorb and relate to. Various delivery methods are deployed and where possible demonstrations and practical work are incorporated to enable the trainees learn by participating in the actual field activities. The use of this TIMPs inventory is expected to contribute to the achievement of the Project Development Objective (PDO), which is to increase market participation and value addition for targeted farmers in select value chains in project areas. This revised TIMPs inventory is to be used in conjunction with the respective ToT Manual.

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

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

PREFACE

The National Agricultural Value Chain Development Project (NAVCDP) is a Government of Kenya project with support from the World Bank. The five-year project is being implemented in 34 counties clustered in seven regions at an approximate cost of U$ 275 million. The project development objective (PDO) is "increase market participation and value addition for targeted farmers in select value chains in project areas." It is expected that this objective will be achieved through implementing the five project components, namely; Building Producer capacity for climate resilient stronger value chains; Climate Smart Value Chain Ecosystem Investments; Piloting Climate Smart Safer Urban Food Systems; Project Coordination and Management; and Contingent Emergency Response Component.

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

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

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

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

Samuel Guto, PhD
National Project Coordinator
National Agricultural Value Chain Development Project

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ABBREVIATIONS AND ACRONYMS

AAK	Agrochemical Association of Kenya
AEZ	Agroechological Zone
AFA	Agricultural and Food Authority
AGRA	Alliance for a Green Revolution in Africa
AIP	Agricultural Innovation Platform
AMRI	Agricultural Mechanization Research Institute
ASK	Agricultural Society of Kenya
ASALs	Arid and Semi-Arid Lands
CBO	Community Based Organization
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Center for Tropical Agriculture
CCP	Critical Control Points
CSA	Climate Smart Agriculture
CoG	Council of Governors
FBO	Farmer Based Organization
FFBS	Farmer Field and Business School
FFS	Farmer Field School
FPEAK	Fresh Produce Exporters Association of Kenya
FAO	Food and Agriculture Organization
FCRI	Food Crop Research Institute
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
GHG	Greenhouse Gas
GPS	Global Positioning System
GMP	Good Manufacturing Practice
GHP	Global Health Partnerships
HACCP	Hazard Analysis Critical Control Points
HCD	Horticultural Crops Directorate
ICIPE	International Centre of Insect Physiology and Ecology
ICRI	Industrial Crops Research Institute
ICM	Integrated Crop Management
ICRAF	International Centre for Research in Agroforestry (World Agroforestry Centre)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ILRI	International Livestock Research Institute
IMM	Integrated Manure Management
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
iSDA	Innovative Solution for Decision Agriculture
ISFM	Integrated Soil Fertility Management
IWM	International Water Management Institute
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate-Smart Agriculture Project
KAPP	Kenya Agricultural Productivity Project
KAPAP	Kenya Agricultural Productivity and Agribusiness Project
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute

KEPHIS	Kenya Pant Heath Inspectorate Service
KESREF	Kenya Sugar Research Foundation
KES	Kenyan Shilling
KRC	Kenya Red Cross
KSU	KALRO Seed Unit
MESPT	Micro Enterprises Support Programme Trust
MFI	Micro Finance Institutions
MoALFC	Ministry of Agriculture, Livestock, Fisheries and Cooperatives
NARI	National Agricultural Research Institute
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organization
NIB	National Irrigation Board
PTC	Practical Training Center
PCPB	Pest Control Products Board
PPP	Public Private Partnership
SIDA	Swedish International Development Agency
SME	Small and Medium Enterprises
TIMPs	Technologies, Innovation and Management Practices
ToT	Training of Trainer
TSBF	Tropical Soil Biology and Fertility
UoN	University of Nairobi
VC	Value Chain
VMG	Vulnerable and Marginalized Group

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

1.1 Definition of terms

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

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

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

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

1.2 Summary of Inventory of TIMPs in the Mango Value Chain

The inventory process identified 114 TIMPs comprising 65 technologies, 1 innovation and 48 management practices, distributed in the 10 sub-themes, as indicated in Table 1.

Table 1: Summary of Mango TIMPs

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Mango	Improved Mango varieties	14	0	0
Mango	Mango seed system	2	0	0
Mango	GAPs and Food Safety	0	0	2
Mango	Climate smart agronomic management practices in Mango	0	0	9
Mango	Soil Fertility Management	2	1	0
Mango	Soil and Water Management	12	0	1
Mango	Mango Crop health	0	0	20
Mango	Postharvest management	7	0	4
Mango	Mango Value addition	17	0	0
Mango	Mechanization of mango production activities	11	0	0
Mango	Farming Business and	0	0	8

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
	marketing			
Mango	Agricultural policy options	0	0	4
Total	**114**	**65**	**1**	**48**

1.3 Summary of Status of TIMPs in Mango Value Chain

The inventory process resulted in a total of 100 TIMPs that are ready for up-scaling, 12 TIMPs that require validation and 2 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 upscaling	Require validation	Further Research
Mango	Improved Mango varieties	14	0	0
Mango	Mango seed system	2	0	0
Mango	GAPs and Food Safety	2	0	0
Mango	Mango agronomic management practices	9	0	0
Mango	Soil Fertility Management	0	2	1
Mango	Soil and Water Management	13	0	0
Mango	Mango Crop health	20	0	0
Mango	Postharvest management	8	3	0
Mango	Mango Value addition	17	0	0
Mango	Mechanization of mango production activities	7	3	1
Mango	Mango business and Marketing	4	4	0
Mango	Agricultural Policy	4	0	0
Overall Total		**100**	**12**	**2**

Table 3: Inventory of Mango TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Improved Mango varieties	2.1.1 Ngowe	Technology	Ready for Upscaling
	2.1.2 Tommy Atkins	Technology	Ready for Upscaling
	2.1.3 Van Dyke	Technology	Ready for Upscaling
	2.1.4 Kent	Technology	Ready for Upscaling
	2.1.5 Keitt	Technology	Ready for Upscaling
	2.1.6 Apple	Technology	Ready for Upscaling
	2.1.7 Sabine	Technology	Ready for Upscaling
	2.1.8 Haden	Technology	Ready for Upscaling
	2.1.9 Sabre	Technology	Ready for Upscaling
	2.1.10 Peach	Technology	Ready for upscaling
	2.1.11 Kitovu	Technology	Ready for upscaling
	2.1.12 Kimji	Technology	Ready for upscaling
	2.13 Turpentine	Technology	Ready for upscaling
	2.14 .311	Technology	Ready for upscaling
2.2 Mango seed system	2.2.1. Mango propagation through seed	Technology	Ready for upscaling
	2.2.2. Mango grafting	Technology	Ready for upscaling
2.3 Good Agricultural Practices and Food Safety Management Systems	2.3.1 Good Agricultural Practices (GAP) for Mango	Management practice	Ready for upscaling
	2.3.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Mango Value Chain in Kenya	Management practice	Ready for up scaling
2.4 Climate Smart Agronomic practices	2.4.1 Nursery establishment and practices	Management practice	Ready for up-scaling
	2.4.2 Mango top-working	Management practice	Ready for up-scaling
	2.4.3 Mulching of tree	Management practice	Ready for up-scaling
	2.4.4 Mango legume-intecropping	Management practice	Ready for up-scaling
	2.4.5 Mango pollarding	Management practice	Ready for up-scaling
	2.4.6 Mango pruning	Management practice	Ready for up-scaling
	2.4.7 Mango plant spacing	Management practice	Ready for up-scaling
	2.4.8 Maturity indices	Management practice	Ready for up-scaling
	2.4.9 Conservation Agriculture		
	2.5.1 Integrated Manure	Complement	Requires validation

2.5 Soil fertility and water management	Management	ary technology	
	2.5.2 Integrated Soil Fertility Management (ISFM)	Complement ary technology	Requires validation
	2.5.3 Rapid soil testing services	Innovation	Requires validation
	2.5.4 Contour bands	Technology	Ready for up-scaling
	2.5.5 Zai Pits	Technology	Ready for up-scaling
	2.5.6 Bench terraces	Technology	Ready for up-scaling
	2.5.7 Fanya Juu terraces	Technology	Ready for up-scaling
	2.5.8 Stone lines	Technology	Ready for up-scaling
	2.5.9 Retention ditches	Technology	Ready for up-scaling
	2.5.10 Grass strips	Technology	Ready for up-scaling
	2.5.11 Tied ridges /Ridging /Earthing	Technology	Ready for up-scaling
	2.5.12 Rain water harvesting systems (ponds and dams)	Management practice	Ready for up-scaling
	2.5.13 Drip irrigation systems for small scale farmers	Technology	Ready for up-scaling
2.6 Crop Health Integrated Management of Pests and Weeds	2.6.1 Integrated Management of Mango Seed weevil (*Sternochetus mangiferae*)	Management practices	Ready for up scaling
	2.6.2 Integrated Management of Mango fruit fly (*Bactrocera dorsalis; Ceratitis capitata and Ceratitis cosyra*)	Management practices	Ready for up scaling
	2.6.3 Biological Control of Mango mealybug (*Rastrococcus iceryoides using Neem)*	Management practices	Ready for up scaling
	2.6.4 Intergrated Management of Mango thrips (*Selenothrips* spp, *Scirtothrips* spp)	Management practices	Ready for up scaling
	2.6.5 Management of Mango hoppers	Management practices	Ready for up scaling
	2.6.6 Integrated Management of Aphids on Mango	Management practices	Ready for up scaling
	2.6.7 Integrated management of mango anthracnose (*Collectotrichum gloesporioides*) and stem-end rot diseases (*Lasiodiplodia theobromae*)	Management practices	Ready for up scaling
	2.6.8 Integrated management of Powdery Mildew (*Oidium mangiferae*)	Management practices	Ready for up scaling
	2.6.9 Mango scab (*Elsinoe mangiferae*)	Management practices	Ready for up scaling
	2.6.10 Integrated management of Sooty Mold	Management practices	Ready for up scaling

	2.6.11 Management of Pigweed (*Amaranthus hybridus*)	Management practices	Ready for upscaling
	2.6.12 Management of Wandering Jew weed (*Commelina benghalensis*) Oxygonum sinuatum	Management practices	Ready for upscaling
	2.6.13 Management of Gallant Soldier weed (*Galinsoga parviflora*)	Management practices	Ready for upscaling
	2.6.14 Management of Datura Weed (*Datura stramonium*)	Management practices	Ready for upscaling
	2.6.15 Management of three-star thorn thistle weed (*Oxygonum sinuatum*)	Management practices	Ready for upscaling
	2.6.16 Management of Blackjack weed (*Bidens pilosa*)	Management practices	Ready for upscaling
	2.6.17 Management of Goat weed (*Ageratum conyzoides*)	Management practices	Ready for upscaling
	2.6.18 Management of Couch grass weed	Management practices	Ready for upscaling
	2.6.19 Management of Sow thistle weed (*Sonchus oleraceae*)	Management practices	Ready for upscaling
	2.6.20 Management of Dodder weed (*Cuscuta japonica*)	Management practices	Ready for upscaling
2.7 Mango harvest and Postharvest management	2.7.1 Harvesting	Management Practice	Ready for up-scaling
	2.7.2 Appropriate mango Fruit harvesting tool	Management Practice	Ready for up-scaling
	2.7.3 Sorting and grading of mango	Technology	Ready for up scaling
	2.7.4 Zero energy brick cooler	Management Practice	Ready for up-scaling
	2.7.5 Coolbot™ Cold Storage	Technology	Validation
	2.7.6 Wakati™ technology	Technology	Validation
	2.7.7 Use of crates during packaging, storage, transportation and marketing of mangoes	Management Practice	Ready for up-scaling
	2.7.8 Use of Hexanal to extend mango shelf life	Technology	Ready for up-scaling
	2.7.9 Use of Hot water treatment	Technology	Ready for up-scaling
	2.7.10 Mango waxing Technology	Technology	Ready for up-scaling
	2.7.11 Modified Atmosphere Packaging of Mango (Ziploc® and Xtend® bag packaging)	Technology	Validation
2.8 Mango Value Addition	2.8.1 Use Solar drier for dehydration of mango	Technology	Ready for up scaling
	2.8.2 Processing of Mango flour	Technology	Ready for up scaling
	2.8.3 Processing of mango pulp	Technology	Ready for up scaling
	2.8.4 Processing of mango into juice	Technology	Ready for up scaling

	2.8.5 Processing of mango pickles	Technology	Ready for up scaling
	2.8.6 Processing of mango chutney	Technology	Ready for up scaling
	2.8.7 Processing of mango leather	Technology	Ready for up scaling
	2.8.8 Processing of mango jam	Technology	Ready for up scaling
	2.8.9 Processing of mango chips	Technology	Ready for up scaling
	2.8.10 Processing of mango wine	Technology	Ready for up scaling
	2.8.11 Processing of mango Toffee	Technology	Ready for up scaling
	2.8.12 Processing of mango Yogurt	Technology	Ready for up scaling
	2.8.13 Processing of mango into candy	Technology	Ready for up scaling
	2.8.14 Processing of mango into nectar	Technology	Ready for up scaling
	2.8.15 Processing of canned mango	Technology	Ready for up scaling
	2.8.16 Processing of mango salad	Technology	Ready for up scaling
	2.8.17 Processing of mango ice cream	Technology	Ready for up scaling
2.9 Mechanization of Mango production activities	2.9.1 Power Tiller	Technology	Ready for up scaling
	2.9.2 4-Wheeled tractor 50HP	Technology	Ready for up scaling
	2.9.3 Mouldboard plough	Technology	Ready for up scaling
	2.9.4 Disk Harrow	Technology	Ready for up scaling
	2.9.5 Hole boring	Technology	Ready for up scaling
	2.9.6 Backpack Weeder	Technology	Ready for up scaling
	2.9.7 Motorized sprayer	Technology	Ready for up scaling
	2.9.8 Power tree pruner	Technology	Requires validation
	2.9.9 Grafting robot	Technology	Requires further research
	2.9.10 Grafting tool	Technology	Requires validation
	2.9.11 Towable Boomlift Harvesting Machine	Technology	Requires validation
2.10 Mango Farming Business and marketing	2.10.1 Models for market-oriented production of Mangoes	Management Practices	Ready for upscaling
	2.10.2 Building a business plan for	Management practices	Ready for upscaling
	2.10.3 Collective marketing	Management practices	Ready for upscaling
	2.10.4 Profitability analysis – Revieweing performance of mangoagro- enterprise	Management practices	Ready for upscaling
	2.10.5 Market Research for Mango	Management practices	Requires validation;
	2.10.6 Contracted mango production model	Management practices	Requires validation;
	2.10.7 Mango marketing entrepreurship model	Management practices	Requires validation;
	2.10.8 Internet/mobile marketing	Management practices	Requires validation;

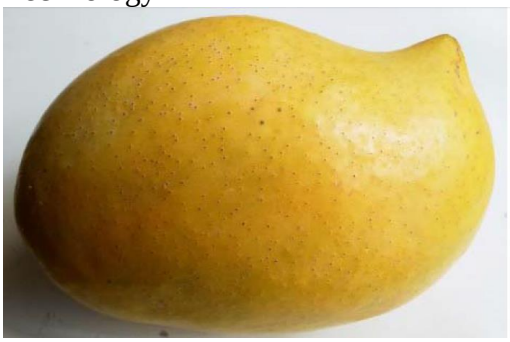
2.11. Mango Agricultural policy options	2.11.1. National Agricultural Framework related to Mango	Management practices	Ready for upsacling
	2.11.2 County Integrated Development Planning	Management practices	Ready for upsacling
	2.11.3 Policy Instruments related to Mango	Management practices	Ready for upsacling
	2.11.4 Policy cycle	Management practices	Ready for upsacling
	Total TIMPs	102	

2.0 DETAILED MANGO VALUE CHAIN TIMPS

Figure 1: Suitability map of Mango in Kenya

2.1 Mango Varieties

2.1.1 Ngowe

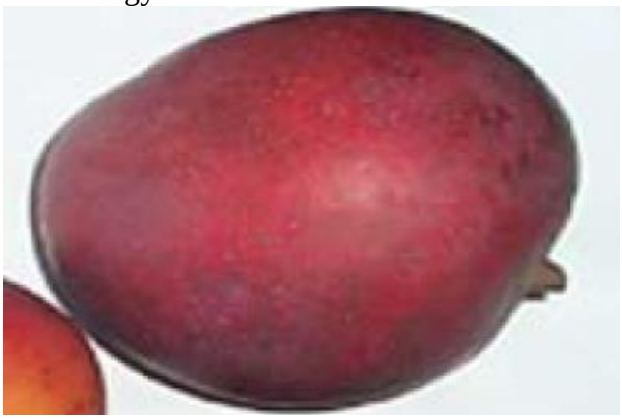
2.1.1 TIMP Name	Mango variety: Ngowe
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Ngowe mango trees are small sized with a rounded canopy. It is a medium yielding and early season (November to March) variety that bears fruits alternately on the stems between. Ngowe fruit is medium to large in size and weigh 523 gm on average. The orange to yellow-coloured fruits (on ripening) are oblong and slender with a prominent beak. The flesh is deep yellow, free from fibre and of excellent quality for use as fresh market and for processing. The variety is moderately tolerant to anthracnose but susceptible to powdery mildew. It also does well in low altitude areas (0-800 metres above sea level)
Justification	As a moderate yielder with a deep yellow and fibre-less flesh, the anthracnose tolerant Ngowe variety is appealing to farmers and consumers who have challenges with low yielding and highly fibrous local mango fruits, respectively
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers, Exporters, Processors, Extension Service Providers, Fruit traders, Researchers, Agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility

	• Training of nursery operators in the various counties on propagation techniques for sustainable supply of quality seedlings • Well organized farmer groups and networks • County and central government support for dissemination of the technologies • Sustainable funding to promote the variety
Partners/stakeholders for scaling up and their roles	• KALRO Stakeholders to undertake adaptive research on current and other new varieties,offer extension service and certified seeds • KEPHIS- ensure seedling quality is maintained • Private sector e.g. nursery operators for upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups; to adopt, test and validate the new technology • County and Central governments: Develop enabling policies and create awareness • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Mombasa, Kilifi, Tana-River and Lamu
Counties where TIMP will be up scaled	Machakos, Makueni, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Limited and unorganized marketing channels • Limited number of extension service providers • Perception towards new technologies
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango • Establish mango innovation platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits • Sensitization on new technology
Lessons learned in up-scaling if any	• Chances of successful scaling up are higher when diverse value chain stakeholders collaborate in innovation platforms • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value
Social, environmental, policy and market conditions necessary for	• Change of attitude by farmers towards adoption of new mango varieties • Existing and new export markets are developed and maintained

development and up scaling	• Appropriate Policies necessary to support seed production, marketing and value addition • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Access and control of land by women is limited • 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 • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Limited access to credit facilities among women.
Gender related opportunities	• The crop being early maturing offers stability to the livelihoods for women and youth • Increased production and sales results in enhanced family incomes. • Potential to create employment for the Youth as nursery operators, service providers and marketing of the produce • Improved food security for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Access and control of land by VMGs is limited • Some of the agronomic practices are not easy to undertake • VMGs lack finances to purchase inputs and to pay for essential services • 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 • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Employment opportunities. • Product diversification and value addition. • The fruit being early maturing offers stability to livelihoods of the VMGs. • Youth could benefit through application of ICT networking for marketing • There in improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Kwale have adopted the variety. • In Makueni County, a mango juice processing plant was constructed to process the mangoes into pulp.

Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). Mango Propagation 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1. Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO-Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF

2.1.2 Tommy Atkins

2.1.2. TIMP Name	**Mango variety: Tommy Atkins**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.

What is it? (TIMP description).	Tommy Atkins is an early to mid-season cultivar that is high yielding (400-600 fruits/tree/season). The tree is large and has a compact rounded canopy. The variety is slightly tolerant to anthracnose disease and is best suited for cultivation in mid altitude areas (800-1600 metres above sea level). It bears fruits consistently which matures between Jan-March. The fruits are orange/yellow with a heavy red blush and numerous white lenticels. Tommy atkins fruits are sweet and fibreless, medium to large sized with an average weight of 522g, oval to oblong shaped (average length 12.6 cm and width 9.9 cm) and a broadly rounded base.
Justification	Local mango fruits have low productivity and poor quality comprising of small fruits that have fibrous flesh. These fruits are unappealing to consumers and therefore attract lessreturns than the improved varieties of superior quality. Providing high yielding and high quality fruit varieties such as Tommy Atkins will improve the productivity of mango farming and hence household incomes and nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers, Exporters, Processors, Extension Service Providers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals. • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Training of nursery operators in the various counties on propagation techniques for sustainable supply of quality seedlings • Well organized farmer groups and networks • County and central government support for dissemination of the technologies • Sustainable funding to promote the variety • Promotion methods
Partners/stakeholders for scaling up and their roles	• KALRO - Undertake adaptive research on current and other new varieties, offer extension services, avail quality planting material and technical advice • KEPHIS- ensure seedling quality is maintained • CBOs, NGOs- Seed multiplication and technology dissemination • Market players to create a demand and therefore increase area under production

	• Farmers/farmer groups to adopt, test and validate the new technology • County and National governments: development of enabling policies, extension services and creation of awareness. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Meru, Muranga, Marakwet, Kitui, Machakos, Makueni, Kwale and Kilifi
Counties where TIMP will be up scaled	Machakos, Makueni, Kitui, Embu and Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Limited access to quality seedlings • Perception towards new varieties • Inadequate service providers • Limited and unorganized marketing channels
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango • Establish mango innovation platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value is critical in upscaling
Social, environmental, policy and market conditions necessary for development and up scaling	• Change of attitude by farmers towards adoption of new mango varieties • Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Appropriate Policies necessary for encouraging implementation of mango value chain • Favourable weather condition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380 Total variable costs per ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limited access and control of resources such as land by women • 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 • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles

	• Limited access to credit facilities
Gender related opportunities	• The fruit being high yielding and tolerant to diseases improves incomes for women and youth • Employmemnt and business opportunities • Opportunities for women employment exists in the various node of the value chain • Increased production and sales results in increased incomes for both women and youth • Improved food security and nutritionfor women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are not easy to undertake • Low access to markets • Financial constraints • Access and control of land by VMGsis limited • Some of the agronomic practices are not easy to undertake • VMGs may have limited access to finances to buy the required inputs such as quality seedlings • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to education, training and extension services than men • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Employment opportunities • Value addition • E-marketing • Potential to create employment for the Youth-Nursery operators, service providers andmarketing of the produce • Improved food security and nutrition for the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	• Farmers in Muranga, Embu, Meru and Makueni have adopted the variety and are producing mangoes for export and local markets.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019) *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO-Horticulture Research Institute, Kandara;

	P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO- Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALF and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.3 Van dyke

2.1.3. TIMP Name	**Mango variety: Van dyke**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Vandyke is a large tree with an open canopy that is best suited for cultivation in mid altitude areas (800-1600 metres above sea level). It is a mid-season variety that is moderate in yielding (28-400 fruits/tree/season). The variety is a regular bearer and comes into bearing in January-March. The fruits are small to medium sized (average weight 280g) and oval shaped (average length 10.5 cm and width 7.6 cm) with a prominent beak. They are bright yellow with a heavy crimson blush, covered by numerous yellow/white lenticels. Its fruits are sweet with little fibre and strong a pleasant aroma.
Justification	Local mango varioties have low productivity and poor quality comprising of small fruits that have fibrous flesh. These fruits are unappealing to consumers and therefore attract less returns than the improved varieties of superior quality. Providing high yielding and high quality fruit varieties such as Van dyke will improve the productivity of mango farming and hence household incomes and nutrition.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Processors, Extension Service Providers, fruit traders
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals. • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Chances of successful scaling up are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value.
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support. • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups - adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions: Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Makueni and Murang'a where the fruits are grown for local and export markets
Counties where TIMP will be up scaled	Machakos, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Inadequate extension service providers • Negative perception towards new varieties • Limited and unorganized marketing channels
Suggestions for addressing the challenges	• Establish certified nurseries in mango producing areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango. • Establish mango innovation platforms

	• Sensitization of public on new varieties • Recruitment of extension service providers • Develop user friendly interactive platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value enhances adoption
Social, environmental, policy and market conditions necessary for development and up scaling	• Change of attitude by farmers towards adoption of new mango varieties • Favourable weather conditions • Market availability • Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Relevant Policies to support the value chain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/ season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and upscaling	• Limited access and control of productive resources such as land, especially for women • Women have limited access to extension services and new technologies • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Limited access to credit facilities for farming
Gender related opportunities	• Potential to create employment for the Youth-Nursery operators, service providers and marketing of the produce • Opportunities for women employment exists in the various node of the value chain • Increased production and sales results in increased incomes for both women and youth • High yielding and quality offers opportunity for diversification and value addition • Improved food security and nutrition for women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are not easy to undertake • Low access to markets and market information • VMGs lack finances to purchase inputs and to pay for essential services • VMGS have limited access and control to resources such as land • VMGs have limited access to extension services and technology

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Can create employment for VMG across all the segments of the value chain. • Increased production and sales results in increased incomes for VMGs • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu, Muranga and Makueni have adopted the variety and are producing quality fruits for local and export markets
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation??* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO-Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO-Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS), ICRAF.

2.1.4 Kent

2.1.4. TIMP Name	Mango variety: Kent
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Kent is a high yielding (450-800 fruits/tree/season) and late season variety that comes into bearing in late February-April and shows a tendency towards alternate bearing. The tree is large with an upright canopy and is best suited for cultivation in mid altitude areas (800-1600 metres above sea level). Fruits are large in size with an average weight of 545g and oval shaped (average length 12.4 cm and width 9.7 cm). They are greenish-yellow with a red/crimson blush and numerous yellow lenticels. Upon maturity, the fruits are sweet, fibreless, strong flavored and have a long shelf life.
Justification	Local mango fruits have low productivity and poor quality comprising of small fruits that have fibrous flesh. These fruits are unappealing to consumers and therefore attract less returns than the improved varieties of superior quality. Providing high yielding and high quality fruit varieties such as Kent will improve the productivity of mango farming and hence household incomes and nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, Exporters, Processors, Extension Service Providers and Researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	• Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value. • Promotion methods • Preferred traits by farmers, consumers and market niches
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer extension and technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators and upscale of seedling production and availability • Market players to create a demand and hence increase area under production • Farmers/farmer groups - adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions - Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Makueni and Murang'a where the fruits are grown for local and export markets
Counties where TIMP will be up scaled	Machakos, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Few or lack of extension service providers • Negative perception towards new varieties • Limited and unorganized marketing channels
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango. • Establish mango innovation platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate

	• Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value improves adoption
Social, environmental, policy and market conditions necessary for development and upscaling	• Change of attitude by farmers towards adoption of new mango varieties • Favourable weather conditions • Market availability • Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Relevant policies to support the value chain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380, Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and up scaling	• Limited access and control of land by women • Youth and women have limited access to agricultural trainings and education • Women and youth lack finances Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have limited access to credit facilities to purchase improved seedlings • Involve men and women in testing of varieties to ensure their preferred quality traits and cropping systems are selected • Target both men and women in scaling up to ensure varieties promoted are adopted • High yield results in increased labour demand for harvest
Gender related opportunities	• Potential to create employment opportunities such as - Nursery operators, service providers and marketing of the produce • Increased production and sales resulting in increased household incomes • Improved food security and nutrition for all
VMG issues and concerns in development, dissemination, adoption and scaling up	• Low access to markets and market information • VMGs lack finances to purchase inputs and to pay for essential services • VMGS have limited access and control to resources such as land • VMGs have limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across all the segments of the value chain. • There will be improved income for VMGs leading to increased decision making • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Embu, Muranga and Makueni have adopted the variety and are producing quality fruits for local and export markets.
Application guidelines for users	**Reference** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation????* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1 Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara; P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Thika Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS), ICRAF.

2.1.5 Keitt

2.1.5. TIMP Name	Mango variety: Keitt
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Keitt mango variety is a moderately vigorous tree with long arching branches and a scraggy open canopy. It has a fair tolerance to anthracnose disease. The variety is best suited for cultivation in mid altitude areas (800-1600 metres above sea level). It is high yielding and late season variety (March-April) that bears fruits regularly. The fruits are large sized (average weight 456g), plump and oval shaped (average length 11.7cm and width 9.2 cm). They are greenish-yellow with a red/pink blush and numerous white, yellow or red lenticels. The flesh is deep yellow juicy and with a little fibre near the seed. The fruits have a long shelf life but susceptible to sunburn.
Justification	Most of the local mango fruits are early maturing and of poor quality making them unappealing to consumers due to less return than the improved varieties which are of superior quality. The late maturing variety that has a long holding period onto the trees is a best bet for farmers targeting.. Providing a late maturing, high yielding and good quality fruit varieties such as Keitt enables farmers to improve production and incomes especially during periods of low supply in the market
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, Exporters, Processors, Extension Service Providers Researchers and agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print

	• Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value. • Preferred traits by farmers, consumers and market niches • Promotion methods used
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS – Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groupsv- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Makueni and Murang'a where the fruits are grown for local and export markets
Counties where TIMP will be up scaled	Machakos, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Lack of extension service providers • Negative perception towards new mango varieties • Limited and unorganized marketing channels
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango. • Establish mango innovation platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits • Campaign for attitude change • Support improved extension services
Lessons learned in up scaling if any	• Successful upscaling are higher when diverse value chain stakeholders collaborate

	• Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value improves adoption.
Social, environmental, policy and market conditions necessary for development and up scaling	• Change of attitude by farmers towards adoption of new mango varieties • Favourable weather conditions • Market availability • Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Relevant policies to support the value chain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/season (109,044 per acre/season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and upscaling	• Limited access and control of productive resources such as land especially by women • Limited access to extension services and new technologies especially by women • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have limited access to credit facilities to purchase inputs • High yield often leads to labour demand for mango harvesting
Gender related opportunities	• Potential to create employment for women and youth especially in Nursery operations, • The fruit being late maturing offers stability to the livelihoods for women and youth • Increased production and higher sales results due to longer shelf life results in increased incomes Improved household food security
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are favorable for VMGs • Low access to markets and market information • VMGs lack finances to purchase inputs • Limited access and control to resources such as land • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Can create employment for VMG across the value chain. • Late maturity of the fruit stabilizes livelihoods and incomes of VMGs • Improved nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Embu, Muranga and Makueni have adopted the variety and are producing quality fruits for local and export markets

Application guidelines for users	**Reference** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
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Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF

2.1.6. TIMP Name	**Mango variety: Apple**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa

A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	The Apple mango variety is a medium yielding and an early season variety (December-March) with a tendency to bear fruits alternately. The tree is large with a pyriform canopy and best suited for cultivation in low altitude areas (0-800 metres above sea level). However, it is susceptible to anthracnose and powdery mildew. . The fruits are medium to large in size with an average weight of 397g and round in shape (average length 9.7cm and width 11.0 cm). They have a deep yellow/orange to red colour. The flesh is yellow, juicy, fibreless and with excellent flavour.
Justification	Local mango fruits have low productivity and poor quality comprising of small fruits that have fibrous flesh. These fruits are unappealing to consumers and therefore attract less return than the improved varieties of superior quality. Providing high yielding and high quality fruit varieties such as Apple will improve the productivity of mango farming and enhance household incomes and nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Producers, Exporters, Processors, Extension Service Providers, Researchers and Agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value. • Preferred traits by farmers, consumers and market niches • Promotion methods used
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production

	• Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Makueni and Murang'a where the fruits are grown for local and export markets
Counties where TIMP will be up scaled	Machakos, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Limited or ack of extension service providers • Negative perception towards new varieties • Limited and unorganized marketing channels
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Train more nursery operators (Youths, VMGs and Women) on propagation techniques for mango. • Establish mango innovation platforms • Promote appropriate marketing channels e.g. Price negotiation platforms between producers and buyers, contract farming, collective production, establishment of collection centres for marketing the fruits • Advocate for attitude change • Support improved extension services
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnerships are important in technology dissemination and adoption and this can be facilitated through innovation platforms • Farmer sensitization on the importance of the variety and its market value improves adoption • Succesful variety promotion requires a ready and consistent market.
Social, environmental, policy and market conditions necessary for development and up scaling	• Change of attitude by farmers towards adoption of new mango varieties • Favourable policies to support quality seed/production, marketing and value addition • Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Favourable weather conditions • Existing and new export markets are developed and maintained • Appropriate Policies necessary for encouraging implementation of agro forestry practices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year

Gender issues and concerns in development,dissemination, adoption and scaling up	• Limited access to and control of land resource especially by women and youths • Youth and women have limited access to agricultural trainings and education • Women and youth lack finances Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Limited access to credit facilities to purchase improved seedlings • Higher yield often result in increased labour demand especially during harvest
Gender related opportunities	• Potential to create employment for the Youths, Nursery operators, service providers and marketing of the produce • Increased production and higher sales results due to longer shelf life results in increased incomes • Improved household food security
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are not suitable for VMGs • Low access to markets and market information • VMGs lack finances to purchase needed inputs attributed to limited access to credit facilities • VMGS have limited access and control to resources such as land • VMGs have limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Employment opportunities across all segments of the value chain. • Increased production hence improved • Improved nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	• Farmers in Embu, Muranga and Makueni have adopted the variety and are producing quality fruits for local and export markets.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	

Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALF and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

12.1.7 Sabine

2.1.7. TIMP Name	**Mango variety: Sabine**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Sabine is a late maturing variety (Late January-March) that bears fruits regularly. The tree is vigorous, dense and has some resistance to powdery mildew and anthracnose. The variety is best suited for cultivation in mid altitudes (800-1600 metres above sea level). Its fruits are medium to large in size (average weight 435g) and elongated in shape (average length 14.2cm and width 6.6 cm). They have a bright yellow and a red blush. The flesh is yellow, juicy, fibreless and with a mild flavour.
Justification	Local mango fruits have low productivity and poor quality comprising of small fruits that have fibrous flesh. These fruits are unappealing to consumers and hence attract less return than the improved varieties of superior quality. Providing high yielding and high quality fruit varieties such as Sabine has the potential to improve the productivity of mango farming and enhance household incomes and nutrition.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, Exporters, Processors, Extension Service Providers, Researchers and agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Preferred traits by farmers, consumers and market niches • Well organized farmer groups and networks • County and National government support • Funding to promote the varieties • Promotion methods • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy development, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Muranga
Counties where TIMP will be up scaled	Machakos, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Lack of extension service providers • Farmer perception towards improved varieties • Unorganized marketing channels for fruits and seedlings
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas

	• Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Farmers' willingness • 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 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land • Access to extension services and new technologies • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Access to credit facilities
Gender related opportunities	• Potential to create employment for women andthe Youths, Nursery operators, service providers andmarketing of the produce • The fruit being late maturing offers stabilityto the livelihoods for women and youth • Improved economic for women enables them to participate in making key decisions in their household • Increased production results in enhanced household food security and income. • Improved food securityfor women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Financial constraints to purchase essential inputs • Unfavourble agronomic practices • Limited access to markets and market information • Limited access to credit facilities • Access and control of resources such as land • Access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities

	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment across the value chain. • Economic empowerment that enables them to participate in making decisions • Late maturing fruits enables VMGs to have stable incomes • Improved food security andnutrition for VMG
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Muranga have adopted the variety
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	2-Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.8 Haden

2.1.8. TIMP Name	Mango variety: Haden
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Haden is a high yielding (450 fruits/tree/season) and early season variety (January-March). The fruits are medium to large sized (average weight 431g) and ovate shaped (average length 10cm and width 8cm). They have a deep yellow with a deep crimson/red blush with whitish/yellow lenticels. The flesh is deep yellowish orange, juicy and with excellent aroma. The tree is large and spreading and susceptible to anthracnose. The variety is best suited for cultivation in mid altitude areas (800-1600 meters above sea level).
Justification	Haden mango variety has good quality medium to large fruits with an appealing colour to consumers making it a good option for introduction and upscaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers, exporters, processors
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and central government support • Funding availability to promote the varieties • Methods of promotion

Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, provision of extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Murang'a
Counties where TIMP will be up scaled	Machakos, Makueni, Kitui, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction between stakeholders • Lack of quality seedlings • Negative perception towards new varieties • Few or lack of extension service providers • Unorganized marketing channels for fruits and seedlings
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favourable weather conditions • Market availability • Existing and new export markets are developed and maintained • Favourable policies to support seed/production, marketing and value addition. • Farmers willingness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs per ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year

Gender issues and concerns in evelopment, dissemination, adoption and scaling up	• Access and control of land by women is limited • Limited access to extension services among women and youths • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Limited access to credit facilities
Gender related opportunities	• Creation of employment across the value chain • Improved yields leads to enhanced household food security and income
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are not favourable to VMGs • Low access to markets and market information • Limited access to credit facilities among the VMGs • Limited access and control of land among the VMGS • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs that enables them participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu, Muranga counties have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	2. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa**

	Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.7 Sabre

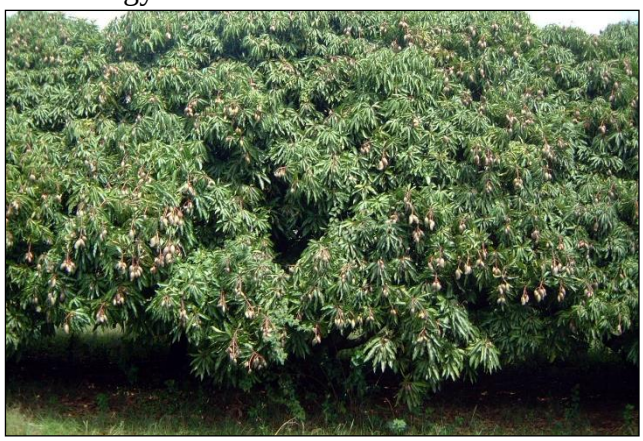
2.1.9. TIMP Name	**Mango variety: Sabre**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Sabre is a high yielding and early maturing variety (December-March). The fruits are medium sized (average weight 180-290g), kidney-shaped with a prominent beak (average length 11.8cm and width 6.9cm). They are yellow-green with a reddish blush. The flesh is deep orange, juicy with moderate fibre and a turpentine after-taste. The tree is medium size and fairly resistant to diseases. It is used as a rootstock to other mango varieties
Justification	Sabre is an excellent rootstock variety that is used to create dwarfism in other varieties. It is therefore a valuable variety for nursery operators and a good option for introduction and upscaling in order to improve productivity and incomes. Providing high yielding and high quality fruit varieties such as Sabre will improve the productivity of mango farming and hence household incomes and nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, exporters, processors
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print

	• Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and National government support • Funding to promote the varieties • Promotion methods • Preferred traits by farmers, consumers and market niches
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni
Counties where TIMP will be up scaled	Machakos, Kitui, Makueni, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Limited number of extension providers • Wrong/negative perception towards new mango varieties • Unorganized marketing channels for fruits and seedlings
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Enhance capacity on provision of extension services • Advocate for attitude change • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Succesful upscaling requires collaboration between the value chain stakeholders • Partnership is important in technology dissemination and adoption • Successful variety promotion requires availability of ready and consistent market for anticipated increased production
Social, environmental, policy and market	• Favourable policies to support seed/production, marketing and value addition Existing and new export markets

conditions necessary for development and up scaling	• Favourable weather conditions • Farmer's willingness to adopt
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/season (109,044 per acre/ season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Access and control of land by women is limited • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment –across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its height
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the agronomic practices are not suitable for VMGs • Low access to markets and market information • Limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling; 2-requires	3. Ready for up scaling

validation; 3-requires further research**)**	
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.10 Peach

2.1.10 TIMP Name	**Mango variety: Peach**
Category (i.e. technology, innovation or management practice)	Technology  Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	High productivity and small sized fruits.
What is it? (TIMP description)	Peach is a high yielding and early variety (December-March). The fruits are small in size (average weight 80-100g) and round-shaped with a depressed beak (average length 5.8cm and width 3.9cm). They are brown-green with a reddish blush. The flesh is deep orange, juicy with fibre and a sweet-taste. The tree is medium size and fairly resistant to diseases. It is used as a rootstock to other mango varieties.
Justification	Peach is an excellent rootstock variety that is used to create dwarfism in other varieties. It is therefore a valuable variety for nursery

	operators and a good option for introduction and upscaling in order to improve productivity and incomes. As a high yielding and high quality fruit variety Peach has the potential to improve the productivity of mango farming through quality medium sized marketable fruits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, service providers, nursery operator, agri-preneurs and Researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and central government support • Funding to promote the varieties • Promotion methods • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions - Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni
Counties where TIMP will be up scaled	Machakos, Kitui, Makueni, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Unorganized marketing channels for fruits and seedlings • Few or no extension service providers

Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Enhance provision of extension services • Advocate for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained • Policies to encourage agro forestry practices are implemented. • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land by women is limited • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment – across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its height
VMG issues and concerns in development, dissemination, adoption and scaling up	• Low access to markets and market information • limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.11 Kitovu

2.1.11 TIMP Name	Mango variety: Kitovu
Category (i.e. technology, innovation or management practice)	Technology  Photo by source: KEFRI-KARI Mango Research
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Kitovu is a high yielding and early maturing mango variety (December-April). Its fruits are small sized (average weight 100-150g), kidney-shaped with a prominent end (average length 6.8cm and width 4.9cm). They are yellow-green with a greenish blush. The flesh is deep orange, juicy with fibre and a turpentine after-taste. The tree is medium size and fairly resistant to diseases. It is suitable for use as a rootstock to other mango varieties
Justification	Kitovu is an excellent rootstock variety with potential to improve local varieties by confering desirable qualities such as dwarfism, taste, fruit fibre and good fruit colour..It is therefore a valuable variety for nursery operators and a good option for introduction and upscaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, Service providers, nursery operators, researchers and agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and National government support

	• Funding to promote the varieties • Methods of promotion • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni
Counties where TIMP will be up scaled	Machakos, Kitui, Makueni, Baringo
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Unorganized marketing channels for fruits and seedlings • Few or no extension service providers • Wrong or negative perception towards new varieties
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Successful upscaling requires collaboration between stakeholders in the value chain • 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	• Favourable policies to support seed/production, regulation, marketing and value addition. • Existing and new export markets are developed and maintained • Policies to encourage agro forestry practices are implemented. • Favourable weather conditions • Market availability

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land by women is limited • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its height
VMG issues and concerns in development, dissemination, adoption and scaling up	• Low access to markets and market information • limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County adopted the variety and have since been reporting good yields.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038

	OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF

2.1.12 Kimji

2.1.12. TIMP Name	**Mango variety: Kimji**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Kimji is a high yielding local mango variety. Its fruits are small in size (average length 5.5cm and width 3.5cm) with a kidney shaped. They are yellow-green in colour. The flesh is deep orange, juicy with moderate fibre and has a sweet after-taste. The variety has a large tree and is fairly resistant to diseases. It is best used as a rootstock in mango grafting.
Justification	Kimji is an excellent rootstock variety used to confer disease resistance and good fruit qualities to other varieties. It is a valuable variety for nursery operators and thus the best bet for introduction and upscaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, exporters, processors, researchers and Agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and National government support • Funding to promote the varieties • Promotion methods • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS – Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups - adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni, Kwale, Kilifi, Lamu
Counties where TIMP will be up scaled	Machakos, Kitui, Makueni, Baringo, Meru, Murang'a
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Unorganized marketing channels for fruits and seedlings • Few or no extension service providers • Wrong or negative perception towards new varieties
Suggestions for addressing the challenges	• Establishcertified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Enhance provision of extension services • Advocate for attitude change

Lessons learned in up scaling if any	• Successful upscaling requires collaboration between the stakeholders in the value chain • 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	• Favourable policies to support seed/production, regulation, marketing and value addition. • Existing and new export markets are developed and maintained • Policies to encourage agro forestry practices are implemented. • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha/ season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limited access and control of land • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment –across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its height
VMG issues and concerns in development, dissemination, adoption and scaling up	• Low access to markets and market information • limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by

	Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F. N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.13 Turepentine

2.1.13. TIMP Name	**Mango variety: Turpentine**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Turpentine variety is a high yielding mango variety that can withstand salinity. The fruit is small, round to ovate in shape and yellow in colour. The yellow flesh is extremely fibrous, with common classic flavour. Some turpentines carry a stronger resin component while others are sweeter, and with tolerable fibre. The fruit tree exhibits dwarfism and fairly resistant characteristics. It is used as a rootstock to other mango varieties.

Justification	Turpentine is a good rootstock variety that is used to create dwarfism in other varieties. It is therefore a valuable variety for nursery operators and a good option for introduction and upscaling in order to improve productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, exporters, processors, Nursery operators, agri-prenuers and Researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and central government support • Funding to promote the varieties • Methods of promotion • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS – Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups - adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni, Baringo
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Unorganized marketing channels for fruits and seedlings

	• Few or no extension service providers • Wrong or negative perception towards new varieties
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favourable policies to support seed/production, regulation, marketing and value addition. • Existing and new export markets are developed and maintained • Policies to encourage agro forestry practices are implemented • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Limited access and control of land • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment –across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its heigh
VMG issues and concerns in development, dissemination, adoption and scaling up	• Low access to markets and market information • limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies

VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F. N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.1.14 311

2.1.14. TIMP Name	Mango variety: 311
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	Mango variety 311 is a high yielding and early variety. The fruits are small (average weight 50-80g), with an average length of 4.0 cm and width 3cm. They are green in colour. The flesh is deep orange, juicy has many fibres. The tree is medium in size, salt tolerant and fairly resistant to diseases. It is used as a rootstock to other mango varieties.
Justification	Mango variety 311 is a good rootstock variety used to confer diseaseresistance, dwarfism and salt tolerance in other varieties.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Producers, Nursery Operators, researchers and agri-preneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Seedling availability and accessibility • Well organized farmer groups and networks • County and central government support • Funding to promote the varieties • Methods of promotion • Stakeholder involvement

Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS – Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups - adopt, test and validate the new technologyNational and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Muranga, Makueni, Kitui, Makueni, Baringo
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • Unorganized marketing channels for fruits and seedlings • Few or no extension service providers • Wrong or negative perception towards new varieties
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Promotion of the variety in the suitable production areas • Promote agro processing and value addition to stimulate demand for seedlings • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favourable policies to support seed/production, regulation, marketing and value addition. • Existing and new export markets are developed and maintained • Policies to encourage agro forestry practices are implemented. • Favourable weather conditions • Market availability

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 47,380. Total variable costs /ha (KES 18,952 per acre) in the 8th year
Estimated returns	• Gross margin KES 272,610 per ha per season (109,044 per acre per season) in the 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Limited access and control of land • Limited access to extension services among women and youths • Limited access to markets among women as they sometimes cannot travel to far markets due to their domestic roles
Gender related opportunities	• Creation of employment –across the value chain • Improved yields often leads to enhanced household food security and income • The fruit solves the challenges experienced by women in harvesting mangoes due to its height
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to markets and market information • limited access to credit facilities • Limited access and control of resources such as land especially among women • Limited access to extension services and technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies
VMG related opportunities	• Creation of employment for VMG across the value chain. • Improved economic empowerment for VMGs enables them to participate in making decisions • Improved food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Embu County have adopted the variety.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara

	P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS) and ICRAF.

2.2 Mango Seed Systems

2.2.1 Mango propagations through seed

2.2.1 TIMP Name	**Mango propagation through seed**
Category (i.e. technology, innovation or management practice)	Management practice  
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of quality planting materials and poor germination of mango seeds planted directly in the farms.
What is it? (TIMP description)	Mango seed propagation is the most common method of propagation by farmers who have limited access to quality grafted mango seedlings in the tropics. The technique involves planting the mango seed which remains viable for only a short period of time (3 to 5 weeks) after complete removal of husk before drying. Where the seed cannot be planted within a few days after its removal from the fruit, it is covered with moist earth, sand, or sawdust in a container until it can be planted. Husk removal is a two-step process: 1. The husk is opened with a sharp knife without cutting the kernel.

	2. The dehusked kernels are treated with fungicide and immediately planted before they dry out.   
Justification	Majority of the farmers have limited or no access to grafted mango seedlings and hence plant their mango trees directly from seed. However, the germination rate and vigour of seedlings planted using this method have reduced especially when seeds are from immature and unripenned fruits. Selection of quality mango fruits from high yielding trees for seeds is very important in mango farming. Training of mango farmers in seed selection and extraction ensure the varieties are maintained in their farms.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Nursery owners, Researchers, Extension service providers, Researchers and agriprenuers.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Development of good seed systems to backstop own seed selection • Seed availability and accessibility through mango research • Well organized farmer groups and networks • County and National government support • Funding for research, validation and promotion of quality seed production. • Stakeholder invovement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS – Seed quality control

	• CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technology • National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and public awareness • Financial institutions - Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Kwale, Kilifi, Tana-River, Lamu, Taita-Taveta, Makueni, Machakos, Murang'a, Embu, Baringo, Elgeyo-Marakwet, Kitui and Garissa
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality planting materials for mango • Unwillingness of farmers to buy quality planting materials • Low awareness on importance of quality planting materials for mango in most parts of Kenya • Unorganized marketing channels for fruits and seedlings • Few or no extension service providers
Suggestions for addressing the challenges	• Establish mango innovation platforms • Research to develop high yielding superior varieties with quality seed • Dissemination of information on importance of selection of good ripe mangoes for seeds • Train farmers on seed selection and empower their ability to access quality seed • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Support improved extension services • Campaign for attitude change • Involve all the stake holder in tea • County governments, extension, and nursery operators to sensitize farmers on importance of planting quality seed
Lessons learned in up scaling if any	• Successful upscaling requires collaboration between stakeholders in the value chain • Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key • 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	• Creation of awareness on nutritional importance of the mango varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • Favourable weather conditions • Market availability • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development , dissemination, adoption and scaling up	• Land ownership mainly by men who may have no interest in mango farming but are ready to receive the proceeds from mango products. • Financial empowerment; the poor farmers lack funds to acquire quality planting materials • Information flow; slow or little especially for female farmers due to low academic levels • The training materials and strategies are not favorable to women farmers • Laborious production practices
Gender related opportunities	• Women, men and youth friendly production techniques such as mechanization • Empowerment; women and youth to acquire land and other inputs such as quality mango seeds. • Reach out more women groups with the mango seed selection information • Well organized gender friendly nurseries and marketing systems • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on mango seed selection
VMG issues and concerns in development, dissemination, adoption and scaling up	• Laborious production practices • Dissemination methods and documents that are not always easy to understand or access • Low access to quality planting materials for mango • Financial constraints
VMG related opportunities	• Affordable agricultural machines for mango cultivation • Development of friendly training materials with illustrations to enhance communication • Well organized mango seed systems • Empowerment of the VMGs through connection with financial institutions
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mango production system has been very successful and economically important in several parts of Kenya such as Coast, Eastern, and Rift valley regions among others. It is also being cultivated successfully in several countries in the world namely India and the US.

Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	2. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS), ICRAF, University of Nairobi, JKUAT.

Gaps

1. Lack of well-organized seedlings production and delivery system

2.2.2 Mango grafting

2.2.2. TIMP Name	**Mango grafting**
Category (i.e. technology, innovation or management practice)	Technology 

	
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inadequate improved high quality planting materials from grafted seedlings (taking 2-3 years to maturity), with high producvity (1000-2000 fruits per season).
What is it? (TIMP description)	Mango grafting is a seedling propagation technique where rootstock from selected local mango varieties is joined with scions of desirable varieties. Selected fruits have their seeds extracted, planted in pre-germination nursery bedsand then transplanted into polythene bags. After 3 months, seedlings at pencil size thickness are grafted with scions from selected mother plants of the variety intended for propagation. Clean scion and rootstock are cut in wedge shapes then joined together and secured with grafting tape.
Justification	Mango grafting has distinguished itself as a means o increasing availability of clean planting materials of improved mango varieties. It is simple technology of rapid multiplication of quality seedlings. The grafted seedlings take shorter periods to maturity (2-3 years) while trees sown from seed take 5-7 years to start production. Being a technology that is perfected by training and practice, it opens opportunities nursery operators in both gender.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Nursery operators, Mango growers, Extension service providers, Researchers and Agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Skilled service providers; availability of improved varieties for scions • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders

	• Promotion methods
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support • KEPHIS –Seed quality control • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area under production • Farmers/farmer groups- adopt, test and validate the new technology • National and County Ministry of Agriculture and Livestock Development – policy develppment, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Embu, Meru, Kwale, Kilifi, Tana-River, Lamu, Garissa, Kitui
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Limited number of skilled grafters • Limited access to quality water • Limited funding • Unpredictability of demand for mango seedlings by farmers due to erratic weather • Limited access to approved and biodegradable potting bags
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Increased supply of quality mango seedlings from KALRO-KSU nurseries country wide • Build capacity of private sector players and NGOs to supply grafted seedlings • Capacity building of registered nursery operators on mango grafting
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Involvement of private nursery operators, other government agencies (County, KEPHIS and MoA-AFA), and Non-governmental agencies like MESPT expedite the up scaling of the technology. • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions	• Access to suitable water for the nursery • Access to approved potting bags

necessary for development and up scaling	• Adequate capacity of growers to acquire grafted seedlings • Geographical distribution of nursery operators and transport network • Registered and licensed nursery operators • Access to suitable financing by nursery operators • Supportive policies and regulations – licenses and levies • Favourable weather condition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 70,000 (For 1000 seedlings)
Estimated returns	KES 130,000. Net Returns KES 60,000
Gender issues and concerns in development, dissemination, adoption and scaling up	• Increased work burden for women when grafting. • Women and youth have limited access to credit that can be used to buy farm implements than men • Women and youth have limited access to education, training and extension services than men • Mango trees are considered men's enterprises thereby limiting women control and benefits that arise from the produce • Men dominate decisions on mango production at the household and community • Mango trees are considered men's enterprises
Gender related opportunities	• Women, men and youth friendly propagation techniques such as mechanization • Empowerment of women and youth to acquire land and other inputs for quality mango seedlings propagation • Reach out more women groups on mango nursery seedlings propagation. • Well organized gender friendly markets and marketing system for quality mango seedlings • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on quality mango seedlings propagation
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 seed and information on new varieties and production techniques • There is low adoption of the technology by VMGs due lack of awareness
VMG related opportunities	• VMGs have opportunities in seed sorting, potting and grafting • Make training materials with illustrations to enhance communication to all VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Increased uptake of KALRO grafted mango seedlings • Technology adoption among private players and NGOs is increasing

Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness (1-ready for up scaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G. Contacts	
Contacts	The Institute Director, KALRO - Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO - Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, and Watani G.
Partner organizations	KALRO, MoALD and County Department of Agriculture, Kenya Plant Health Inspectorate Services (KEPHIS ICRAF, University of Nairobi, JKUAT.

Research Gaps

1. Validation of appropriate rootstocks including compatibility trials
2. There is need to validate appropriate scion packaging and transportation methods particularly for long distances
3. Fine-tune application as a complementary technology in coppicing and top-working

2.3. Good Agricultural Practices (Gaps) and Food Safety Management Systems

2.3.1 Good Agricultural Practices (GAP) for mango value chain

2.3.1. TIMPs name	**Good Agricultural Practices (GAP) for mango value chain**
Category (i.e.technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor quality and unsafe fruits, and higher risk to workers' safety and health due to limited knowledge on appropriate agricultural practices across the mango value chain actors.
What is it? (TIMP description)	Good agricultural Practices is a systematic process of implementing a standardized production system globally that is designed to reassure consumers on how food is produced in the farm, pre-farm gate or on-farm standards. It is not about a specific crop production but the process through which appropriate production takes place.
Justification	Unsafe fruits, poor quality, poor workers' safety and health poses a threat to the production and marketability of mangos. 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. GAP should be transparent and it involves all value chain players including providers of logistics and farm equipment. Instituting GAPs will enable the mango value chain in Kenya to be more competitive and sustainable
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All mango value chain players including Farmers/producers, extension staff, processors, transporters, researchers, agripreneurs and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Policy support from County and National government • A platform for interaction for mango value chain stakeholders • Well organized networks

	• County and National government support • Funding to promote the varieties • Methods of promotion • Stakeholder involvement
Partners/stakeholders for scaling up and their roles	• KALRO - undertake adaptive research and offer technical support • Farmers/farmer groups- adopt, test and validate the new technology • National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and public awareness • Financial institutions- Provide credit facilities • CBOs, NGOs and other Private sector players – funding and adoption • Private extension providers - dissemination
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive • Few or no extension service providers
Recommendations for addressing the challenges	• Continuous training of farmers, extension staff and other value chain players • Establish mango innovation platforms • Support improved extension services
Lessons learned in up scaling, if any	• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Successful upscaling requires collaboration between stakeholders in the value chain
Social, environmental, policy and market conditions necessary for development and promotion	• Innovative platform to facilitate dissemination of GAP • Environmental conditions are conducive to implementation of the system • Favourable weather conditions to test and validat the GAPs • Market availability the cost of production and also take up the produce • Favourable policies to support GAP adoption.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined

Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up,	• Woment may have less access to information on GAPs than men • Increased work burden for women
Gender related opportunities	• Job opportunity for unskilled women and youth due to systematic method of the processes • Diversification of livelihoods for women and youth • GAPs will increase the benefits of good health to the women and youth, who work more on the farm
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to information on GAPs • Labour intensive nature of some practices are not favorable to VMGs
VMG related opportunities	VMGs may benefit from the extra income and health benefits arising from the enhanced productivity due to application of GAPs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	**Reference:** Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation*
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO - Industrial Crop Research Institute, Mtwapa Antony Nyaga, John Ndung'u, , Francis Wayua, Lusike Wasilwa and Violet Kirigua

2.3.2 Food Safety Management System: Hazard Analyisis Critical Control Points (HACCP) Plan for Mango Value Chain in Kenya

2.3.2. TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Mango 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 risk of the presence of chemical, biological and physical hazards in the mango value chain in Kenya have a direct effect on consumer's health. These hazards have direct health and economic consequences on families, communities and industries involved in the mango value chain. Chemical hazards cause neurological disorders, cancer and birth defects to consumer.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Points (HACCP) in mango value chain is a system that is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring them. It is a preventive, rather than a reactive tool that places protection of mango value chain actors from biological, chemical and physical hazards.
Justification	The risk of the presence of chemical, biological and physical hazards in the mango value chain have a direct effect on consumer health and the economic status of families, communities and industries involved in the mango value chain. Hazard Analysis and Critical Control Points (HACCP) system is incorporated into the world Codex Alimentarius as well as the national public health and food safety legislations of Kenya. The HACCP if adopted, in mango value chain will minimize hazards along the mango value chain, making mango fruits and products safe for consumption. The approach can be applied at all stages of the mango value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Processors, traders, food vendors and consumers.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals

	• Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Involvement of experts and specialist in food safety and quality control (HACCP, KEBS), together with all the value chain stakeholders in dissemination of information • Promotion methods eg availing of printed HACCP plan to mango value chain actors for implementation in order to reduce hazards
Partners/stakeholders for scaling up and their respective roles.	• KALRO: Dissemination and technical backstopping • Institutions responsible for legislating in food safety, regulations and sale of pesticides (KEBS, PCPB etc) • Accredited institutions/laboratories for analytical testing. • PCPB for approval and inspection • Producers, Processors, local traders and exporters associations- implementation • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-dissemination of technology • CBOs, NGO's - Adoption and technology dissemination
C: Current situation and future scaling up	
Counties where already promoted. if any	Kwale, Kilifi, Makueni, Baringo, Embu
Counties where TIMPs will be up scaled	Machakos Kwale, Kilifi, Makueni, Baringo, Embu, Murang'a
Challenges in development and dissemination	• Limited knowledge on HACCP among value chain actors • Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	• Establish mango value chain innovation platforms • Funding of dissemination platforms
Lessons learned in up scaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in adoption, dissemination and upscaling • 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 policies and laws that are supportive to the use of HACCP in mango value chain. • Market availability to absorb the cost of implementation of the system and also take up the produce
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development,dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge on HACCP than men
Gender related opportunities	• Proper application of HACCP will lead to improved health of the various gender categories at household level, due to consumption of clean healthy mango that are free from hazards

VMG issues and concerns in development, dissemination, adoption and scaling up	• Requires a lot of movement on the farm to maintain records and process verification which may be untenable for some VMGs who are elderly and disabled • VMGs have less access to agricultural information, technology and knowledge than men • High illiteracy level among the VMGs makes them unable to read and disseminate information on application of HACCP • Access to information and their channels
VMG related opportunities	• Proper application of HACCP will lead to improved health of the various gender categories at household level, due to consumption of clean and hazard free mango
○ E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	1. Nyagah A., Ndung'u J. N., Ndambuki J., Odhiambo H., Kirigua V., Lusike W. and Macharia G. (August, 2021), Food Safety Culture, 2. Ndung'u J. N.,, Nyagah A., Odhiambo H., Ndambuki J., Kirigua V., Lusike W. and Macharia G. (August, 2021), Mycotoxins 3. Ndung'u J. N.,, Nyagah A., Odhiambo H., Ndambuki J., Kirigua V., Lusike W. and Macharia G. (August, 2021), Physical Hazards in Food. 4. Ndung'u J. N.,, Nyagah A., Odhiambo H., Ndambuki J., Kirigua V., Lusike W. and Macharia G. (August, 2021), Biological Hazards 5. Ndung'u J. N.,, Nyagah A., Odhiambo H., Ndambuki J., Kirigua V., Lusike W. and Macharia G.. (August, 2021), Chemical Hazards 6. Ndung'u J. N.,, Nyagah A., Odhiambo H., Ndambuki J., Kirigua V., Lusike W. and Macharia G. (August, 2021), Hazard Analysis Critical Control Point (HACCP)
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 – Food Crops Research Institute, Njoro P.O. Box 220-01000. **Njoro** Email: cd.njoro@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO – Food Crops Research Institute, Njoro John Ndung'u,Antony Nyaga, Francis Wayua, Lusike Wasilwa, Violet Kirigua and Beatrice Wanjiku

Partner organizations	KALRO, MoALD and County Department of Agriculture, Kenya Bureau of standard, Pest Control and Poison Board (PCPB), CBOs/farmers group and NGOs

2.4 Climate Smart Agronomic Practices

2.4.1 Nursery establishmen and management

2.4.1 TIMP name	**Nursery establishment and management**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Limited access to clean planting materials and low productivity from available seedlings
What is it? (TIMP description)	This is a management practice for raising mango seedlings from seed to maturity in the fields. In nurseries, mango seedlings are propagated through planting of rootstock which are then grafted at pencil size thickness. The resultant seedlings are then intensively managed by application of appropriate nutrition and protecting them from pests and diseases until they attain the transplanting stage.
Justification	Productivity of mango orchards is usually affected by the quality of seedling the farmers' plant. Mostly, farmers plant germinated seedlings of volunteer germinants obtained from other farmers' fields. This results into low productivity. Availability of healthy seedlings is a prerequisite for improved productivity and quality of fruits. Establishment of nureseries is therefore one way of ensuring availability of good quality, disease resistant and high yielding mango planting materials
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Producers, Nursery operators, Extension service providers, Farmers, Agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of appropriate rootstocks • Well trained nursery operators • A suitable site with sufficient water • Accessibility of the site by farmers • Favorable weather conditions

	• Stakeholder involvement (HCDA)
Partners/stakeholders for scaling up and their roles	• KALRO - avail quality rootstock, quality planting material/seedling and offer technical support • Horticultural Crops Directorate –Seed quality control (nursery registration and certification) • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Farmers/farmer groups- adopt, test and validate the practices • National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Embu,Meru, Kitui
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Unavailability of suitable nursery sites • Inadequate number of well-trained nursery operators • Ban on sale and use of polybags to pot the seedlings
Suggestions for addressing the challenges	• Sensitization of farmers on the importance of planting healthy and vigorous seedlings • Have site specific recommendations • Train more nursery operators on proper establishment and management of nurseries • Use of alternative biodegradable polybags • Support improved extension services
Lessons learned in up scaling, if any	• Availability of healthy seedlings can greatly enhance both productivity and quality of mangoes • There is need to stock nurseries with many rootstock seedlings for grafting with scions of different varieties every time the need arises. This will ensure continuous supply of quality seedlings • Successful upscaling requires collaboration with relevant stakeholders in the value chain
Social, environmental, policy and market conditions necessary for development and promotion	• The practice will be acceptable and adopted by farmers. • The target locations will have ecologically suitable conditions for Mango production • The markerts will be able to absorb the produce and recompense farmers adequately • Favorable policies to support nursery establishment and accompanying activities such as sourcing for water, will be friendly • Favourable weather conditions

	• Established nurseries certified by KEPHIS and registered by HCD.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 80 per seedlings
Estimated returns	KES 150 per seedling. Net returns KES 70 per seedling
Gender issues and concerns in development and dissemination, adoption and scaling up	• Limited ownership and control of land among women can limit their participation in nursery establishment • Labour intensity in establishing nurseries can be prohibitive for women • Limited access to capital among women can limit their participation
Gender related opportunities	• Ease of participation of women and youth since the technology does not require extensive land area. • Improved household production and nutrition for women • Improved household food and nutrition security for women
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit facilities, and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Creation of employment for VMG in establishment and maintenance of nursery • Improved food security and nutrition for VMGs • Increased decision making by VMGs at household and community level
E: Case studies/profiles of success stories	
Success stories	The nursery establishment and management technology has been well adopted in Muranga, Embu and Machakos counties where operators are running them as business enterprises.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
F: Status of TIMP readiness **(**1-ready for up scaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling

G. Contacts	
Lead organization and scientists	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org OR The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO - Horticulture Research Institute, Pole F.N, Njuguna K., Gathambiri C, and Watani G., SJN Muriuki, F. Muniu, M. Menza, S. Mwashumbe
Partner organizations	KALRO, ICRAF, University of Nairobi, JKUAT, MoALD and County Department of Agriculture,.

2.4.2 Top-working

2.4.2 TIMP Name	Top-working
Category (technology, innovation or management practice)	**Technology**  
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and high cost of management due to low yielding variety and tall trees that are difficult to manage.
What is it? (TIMP description)	Top-working is the cutting of an existing local mango tree at 1 metre height and grafting them with scions of improved varieties. The scions can be either of the same variety or different varieties that are selected from healthy and high yielding varieties
Justification	Most mango orchards consist of old trees that are low yielding, and produce poor quality mangoes. The trees are difficult to manage in terms of pest and disease protection while harvesting of mature fruits is also a challenge. Coppicing and grafting shortens the time to fruit production as well as ensuring uniformity in maturity of the fruits. The trees become easy to manage

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango growers, Public and private extension service providers, Researchers and Agri-prenuers.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Skilled service providers; • Availability of improved mango varieties to be used in grafting/topworking • Willingness by farmers to have their trees coppiced • Methods of promotion
Partners/stakeholders for scaling up and their respective roles.	Extension workers, NGOs, Private service providers • KALRO - undertake adaptive research, avail improved varieties, extension services and offer technical support • CBOs, NGOs and other Private sector players e.g. nursery operators to upscale seedling production and availability • Farmers/farmer groups- adopt, test and validate the new technology • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted. if any	Kilifi, Kwale, and Lamu, Tana-Rier
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination	• Inadequate service providers • Limited grafting and top-working experts • Land ownership challenges • Limited financial capacity among growers • Farmers willingness to adopt the practice due to lack of alternative source of income • Few or no extension service providers
Suggestions for addressing the challenges	• Upscale training services • Training more experts in grafting • Encourage more participation of NGOs/private partnerships • Support improved extension services • Link the growers to financial institutions

Lessons learned in up scaling, if any	• Availability of cost benefit information enhances adoption • Gradual change of production cycle of aged mango trees of unknown varieties through grafting is more effective • Effective sensitization of farmers encourages them adopt the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	• Favourable policies to promote adoption of technology. • Favourable weather conditions • Market availability for mango
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total cost of coppicing one mango tree is KES 3,000/= Total cost of grafting one seedling is KES. 70/=
Estimated returns	Estimated gross margins for sale of mangoes at 8 years (peak production) is KES 40,000/= per tree per year.
Gender issues and concerns in development, dissemination adoption and scaling up	• Limited ownership and control of land among women limits their participation • Labour intensity in cutting old huge trees can be prohibitive for women • Limited access to capital among women can limit their participation
Gender related opportunities	• Ease of participation of women since the technology is carried out at low heights (1 metre). • The coppiced mango trees can easily be managed (spraying, pruning and harvesting) by women and youths owing to the low height.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to technical training opportunities among VMGs limits their adoption and dissemination.
VMG related opportunities	• Tree size is reduced through the technology making management operations such as spraying, pruning and harvesting easy for women, youth and vulnerable persons. • Offers employment opportunities for VMGs as individuals and as service providers • Application of mechanization such as the use power saw in coppicing creates employment for youth
E: Case studies/profiles of success stories	
Success stories	1. Increased uptake of KALRO mango grafted seedlings 2. Increased mango production by farmers who adopted the technology
Application guidelines for users	1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). *Mango Propagation* 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.

F: Status of TIMP readiness (1-ready for up scaling;, 2-requires validation; 3-requires further research**)**	1. Ready for up scaling
G: Contacts	
Lead organization and scientists	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751 OR The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 Pole F.N, Njuguna K., Gathambiri C, and Watani G.,
Lead organization and scientists	KALRO - Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, Watani G., Muriuki, SJN Muniu, F., Menza, M., S. Mwashumbe
Partner organizations and contacts	KALRO, Pwani University, info@pu.ac.ke.S. Muti; H. Saha. Coast Development Authority, J. Kombe

2.4.3 Mulching of trees

2.4.3 TIMP name	**Mulching of trees**
Category (i.e. technology, innovation or management practice)	Management practice  **Source: https://www.google.com**
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture leading to water stress in the soil; increased emergence of weeds; loss of organic matter; increased soil salinity especially in the ASALs.
What is it? (TIMP description)	Mulching is the process or practice of covering the soil/ground around the plant with dry matter to provide favourable conditions for plant growth, development and efficient crop productivity. Mulching in technical term means 'covering of soil' with natural materials such as leaf, straw, dead leaves and compost.

Justification	Accelerated loss of soil moisture leads to water stress in the soil. The suppression of evaporation has a supplementary effect as it restricts the rise to the surface of salty water in ASAL.. This salty water raises pH compromising growth of plants. Mulching also facilitates retention of soil moisture and helps in moderating temperature fluctuations, improves physical, chemical and biological properties as well as adding nutrients to the soil and ultimately enhancing the growth and productivity of mango plants. Additionally, mulch can effectively minimize water vapour loss, soil erosion, weeds problems and add nutrient in the soil.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, NGOs, agri-preneurs, extension service providers.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of plant or crop residues for mulching • Good control on the competing uses of crop residues • Dry matter that will not germinate and compete for nutrients once applied around the pant • Methods of promotion • County and National government support in dissemination/promotion • Funding to promote the technology
Partners/stakeholders for scaling up and their roles	• KALRO for technology development and establishment of demonstrations mango growing counties • National and County Ministry of Agriculture and Livestock Development – provision of Extension services and 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	Machakos, Makueni, Meru
Counties where technology will be upscaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses. • Problem of termites • Few or no extension service providers
Suggestions for addressing the challenges	• Crop diversification to increase availability of residues. • Adapting alternative mulching materials like high absorbance polymers • Avoid mulch coming it to contact with the plant to minimize termite damage on trees • Treat the soil around the mulched area with a termiticide. • Support improved provision of extension services
Lessons learned in up scaling	• There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes
Social, environmental, policy and market conditions necessary	• Locally available mulch materials are socially acceptable for use • Environment supports generation of mulch materials • Market availability to absorb the extra fruit resulting from improved production • Supporting frameworks/policies at the local level • Favourable weather conditions
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development,dissemination, adoption and scaling up	• Cutting, carrying and laying of mulch may be extra burden for women • Limited access to extension services among women and youths • • Dual purpose crop residues like those used as livestock feed and household fuel often leads to scarcity.
Gender related opportunities	• It is an economical way of managing and utilizing agricultural waste for improved productivity • Increased productivity favors all gender – food security and incomes • Mulching suppresses weeds and hence reduces time spent in weeding by women and youths. • Mulching uses remnants from crop/plants and agro processing thus a low cost and effective technology that is widely adopted and scaled up by women and youths.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some VMGs have problems performing some labour intensive agricultural activities such as weeding or collecting crop residues • VMGs have constraints of paying labourers
VMG related opportunities	• It's an economical way of managing and utilizing agricultural waste for improved productivity • Increased productivity favors all gender – food security and incomes

	• Being low cost technology favors VMG who have limited access to credit.
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Farmers in various counties especially the ASAL areas have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of this widely used and readily available technology.
Application guidelines for users	Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation*
F. Status of TIMPS readiness 1) Ready for up scaling; 2) Requires validation; 3) Requires further research	1. Ready for upscaling 2. Requires validation in some regions and using different mulch materials
G: Contacts	
Lead organization and scientists	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751 OR The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO – Horticulture Research Institute, Kandara Pole F.N, Njuguna K., Gathambiri C, E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau, Njuguna
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture.

2.4.4 Legume Intercropping

2.4.4 TIMP name	Legume Intercropping
Category (technology, innovation or management practice)	Technology  Photo by: Pole F.N.
A: Description of the technology, innovation or management practice	
Problem to be addressed:	• Low yields and resultant low farm returns • Declining soil fertility due to soil degradation. • Crop loss due to weed infestation • Vulnerability to crop pests
What is it? (TIMP description)	Intercropping involves the planting of two or more crops in the same piece of land at the same time. The most common goal of intercropping is to maximize production from a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change. The technique is implemented in two formats; ***Single row intercropping:*** involves the component of mango and the legumes including (*Mucuna pruriens, Dolichos Lablab,* Cowpeas, *Clitoria ternatea* arranged in alternate single rows. *Spacing.* The space between the two mango rows is 12 m and the legume is planted in between. ***Strip intercropping:*** multiple rows, or a strip, of the legume is alternated with single or several rows of mango. *Spacing.* The inter row spacing between legume is 50-60 cm and legume to mango is 60 cm. The space between two mango rows is 12 m.
Justification	Climate change is impacting negatively on agricultural production. Farmers are experiencing low yields, crop failures, declining soil fertility and generally low farm returns from their investments. Intercropping is one of the potential management practices for enhancing production, soil fertility/biodiversity and hence minimizes the effects of climate change. The practice is known to build healthy soils, control weeds and harness a variety of benefits to maximize on land productivity. 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 including; it allows for efficient utilization of light, water, and nutrients as compared to single crops planted in separate areas, and this can improve yields and income. mix cropping also discourages insect pest infestation hence lower pest densities in intecropped fields.Moreover, intercropping allows for more effective management of cover crops.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, NGOs, Extension service providers, Researchers and Agri-prenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Awareness creation on the benefits and contribution of the practice to all stakeholders. • Easy of accessto legume varieties that are compatible with mango plants • Technical packages describing appropriate schedules of planting intercrop. • Package on fertilizer rates and regimes under the practice • County and National government support • Funding to promote the varieties • Methods of promotion
Partners/stakeholders for scaling up and their roles	• KALRO to perfect the technology, establish demonstrations in all mango growing areas, and provide technical and extension support • Ministry of Agriculture and Livestock Development and County Department of Agriculture– to provide extension services, farmer mobilization and policy formulation • CBOs, NGOs and Donors - to provide support on capacity building and micro-financing services • Farmers/farmer groups- adopt, test and validate the new technology.
C: Current situation and future scaling up	
Counties where already promoted	• Most counties in the medium to high rainfall areas as well as the arid and semi-arid areas.
County where TIMP will be up scaled	• All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• High farmer poverty levels coupled with illiteracy especially in deep rural areas of Kenya • Few or no extension service providers • Wrong or negative perception towards the technology.
Suggestions for addressing the challenges	• Train local ToTs to bridge language barrier caused by illiteracy. • Adopt use of pictorials in training materials • Establish demo-farms to induce change of perception • Support improved extension services
Lessons learned in up-scaling, if any	• The practice is very important in pest management.Farmers can use a trap crop to attract pests, keeping them away from the main crop thereby significantly cutting 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 • Establishment of demo farms encourages adoption of technology • Partnership is important in technology dissemination and adoption and can be facilitated by innovation platforms • Intecropping is environmentally friendly and it enhances biodiversity, controls erosion and minimizes use of pesticides
Social, environmental, policy and market conditions necessary for developmemt and promotion	• Availability of many intercrop options avails options for different crop growing environments • Policy environment will be favourable for the practice • Markets will be to favourably absorb the increased produce • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Not yet determined
Estimated returns	• Not yet determined
Gender issues and concerns in development, dissemination	• Women have less access to information, technology and knowledge • Women and youth have limited access to education, training and extension services than men • Men dominate in decision making at the household and community levels • Limited access and control of land especially by women
Gender related opportunities	• Intercropping offers extra income to the household to the benefit of the women • Intercropping offers employment opportunities for women and youth in maitenance of the intercrop • Intercropping may improve nutriotional requirements of the household to the benefit of the women
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge

	• VMGs have limited access to productive resources such as credit, and quality seed for the intercrop • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption of technology by VMGs due lack of awareness
VMG related opportunities	• The practice may be economically viable in trms of employment, for the VMGs • It increases production offering improved and stable incomes, from the produce, for VMG • Intercropping improves production offering food security and nutrition for the household to the benefit of the VMG
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	• Mohler, C. L. (2009). Crop rotation on organic farms: A planning manual. Natural Resource, Agriculture, and Engineering Service (NRAES).
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further research	1. Ready for upscaling
G: Contacts	
Lead organization and scientists	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 OR The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038 Pole F. N, Njuguna K., Gathambiri C, E. Mutuma, P. Kitiem, E. Mutuma, M. Okoti, , D. Kamau, A.O. Esilaba
Partner organizations and contacts	KALRO, MoALD and County Department of Agriculture and KCEP-CRAL project

GAPS

1. Limited information on intercropping performance in specific areas of Kenya. For example, there hasn't been much research on optimal levels of fertilizer use for

intercropping potatoes and legumes in some areas – the need for site specific validation.

2. Limited or no information on the interactions of various intercrops especially in the arid and semi-arid areas (ASALs).
3. Limited knowledge on resource-use efficiency especially in regions with impoverished soils (ASALs).

2.4.5 Pollarding

2.4.5 TIMP Name	**Pollarding**
Category (technology, innovation or management practice)	**Technology**  
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity, aging trees, height hindering pruning and spraying.
What is it? (TIMP description)	Pollarding refers to the rejuvenation of an aging mango tree through cutting down the stump at 1.5m above the ground. The cut tree will sprout to give new shoots that can be well managed to a height amenable for proper harvesting as well as pests and disease control in mango tree and fruits.
Justification	Old mango trees tend to be low producing and have low value. They act as host and sources of pests and diseases that attack newly established trees. At the same time, the tree poses a great challenge during mango fruit harvesting owing to the height and thus lead to high post-harvest losses. Pollarding will rejuvenate the tree by initiating new vegetative growth that also gives more yields than the older branches.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, NGOs, Extension service providers, Researchers and agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Skilled service providers • Extension service providers • Establishment of demonstrations plots in various locationsFinancial support • Methods of promotion
Partners/stakeholders for scaling up and their respective roles.	• , NGOs, private service providers - to mobilise farmers and facilitate technology transfer • KALRO - establish demo farms, offer extension services and technical support • Extension workers, CBOs and NGOs to mobilise farmers and facilitate technology transfer • Farmers/farmer groups- adopt, test and validate the new technology • National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and public awareness • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted. if any	Kilifi, Kwale, Machakos, Tharaka Nithi, Baringo
Counties where TIMPs will be upscaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in and dissemination	• Inadequate personell for extension services • Accessing and mobilizing farmers (groups) for sensitsation fora • Wrong or negative perception towards the technology
Suggestions for addressing the challenges	• Establish demo farms in mango growing regios • Training of trainers from the among the communities • Encourage more participation of NGOs/private partnerships • Support improved extension services • Advocate for attitude change
Lessons learned in up scaling, if any	• Availability of Cost benefit information enhances adoption • Gradual change of production cycle in aged trees through coppicing is possible.
Social, environmental, policy and market conditions necessary for development and up-scaling	• The technology is socially acceptable and environmentally friendly • The market will be able to absorb the extra production • Favourable Policies and market availability for extra production realized • Favourable weather conditions • Market availability for improved production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of pollarding- is KES 2000/- per tree
Estimated returns	• Cash returns:1 tree yields 60kg @ 100 = 6,000 /tree • Intangible benefits from trees:

	○ Environmental conservation- preserving water catchments; ○ Carbon sequestration, addressing global warming
Gender issues and concerns in development, dissemination adoption and scaling up	• Limited ownership and control of land among women can limit their participation • Labour intensity in cutting old huge trees can be prohibitive for women • Limited access to capital among women can limit their implementation of the TIMP • Bias in training opportunities in favour of men on pollarding and top-working • Women face challenges in harvesting mangoes from very tall trees
Gender related opportunities	• Managable tree heights make the mango production system more amenable to intercropping thereby boosting food and nutritional security and incomes for women.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to technical training opportunities among VMGs • The practice is labour intensive rendering it usuitable for VMGs • VMGs may lack the credit facilities to pay for the required labor
VMG related opportunities	• Tree size is reduced through the technology making management operations such as spraying, pruning and harvesting easy for women, youth and vulnerable persons. • The practice may offer employment opportunities to youths such as in cutting of stems
E: Case studies/profiles of success stories	
Success stories	• Increased uptake of the KALRO mango rehabilitation technology by farmers in Tana-River, Kwale and Kilifi counties • Technology adoption among private players and NGOs is increasing
Application guidelines for users	Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). *Mango Propagation*
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires furt*her research)*	1. Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Industrial Crop Research Institute, Mtwapa F.N. Pole, F.K. Muniu, M. Menza, S. Mwashumbe

Partner organizations and contacts	KALRO, Pwani University, info@pu.ac.ke.S. Muti; H. Saha.; Coast Development Authority, J. Kombe, MoALD and County Department of Agriculture

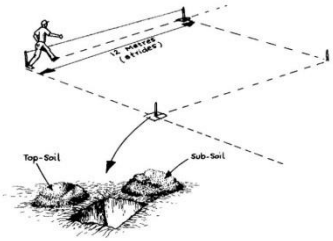
2.4.6 Pruning

2.4.6 TIMP Name	**Pruning**
Category(technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields arising from over grown mango trees exhibiting leaf shading, interlocking branches resulting in low photosynthesis.
What is it? (TIMP description)	Pruning is the surgical removal of interlocking; low lying and unproductive branches of a mature mango tree. It involve cutting of the apical bud of the young tree at 1 metre height to allow the tree to spread; and the removal of all branches below 0.6m above the ground.
Justification	Low yields arise from over grown mango trees exhibiting leaf shading, interlocking branches which causes reduced photosynthesis. Pruned trees permits light penetration and reduction in disease infection and facilitates photosynthesis. This leads to increased yields and improved quality of mangoes for better prices in the market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Mango growers, Public and private extension service providers, NGOs, Researchers and Agri-prenuer.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Skilled service providers; • Availability of appropriate fungicide • County and National government support • Funding to promote the varieties • Methods of promotion
Partners/stakeholders for scaling up and their respective roles.	• County governments - Extension workers to provide sensitization forums for awareness creation, • NGOs to mobilize and train farmers, • Private service providers offer pruning services to farmers at a fee

	• Financial institutions- Provide credit facilities • KALRO to fine tune the technology and offer technical backstopping to the farmers
C: Current situation and future scaling up	
Counties where already promoted, if any	Kilifi, Kwale, Tana River and Lamu
Counties where TIMPs will be upscaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination	• Inadequate service providers • Limited Expertise in pruning • Wrong or negative perception towards new varieties
Suggestions for addressing the challenges	• Encourage participation of NGOs/private partnerships • Training more experts in pruning • Support provision of extension services
Lessons learned in up scaling, if any	• Pruned trees give more yields • Pruned trees are easy to manage
Social, environmental, policy and market conditions necessary for development and up-scaling	• The practice will be socially acceptable and appropriate to the communities • The market will be able to take up the extra and high quality produce. • Favourable weather conditions • Market availability • Favourable policies to support seed/production, regulation and marketing
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up	• Limited ownership and control of land among women can limit their participation • Labour intensity in cutting old huge trees can be prohibitive for women • Limited access to capital for pruning among women can limit their participation
Gender related opportunities	• Tree size is reduced through pruning making management operations such as spraying, and harvesting easy for youth • Pruning offers employment opportunities for the youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited access to technical training opportunities among VMGs due t their marginalisation • Labour intensity in cutting old huge trees can be prohibitive for VMGs
VMG related opportunities	• Tree size is reduced through pruning making management operations such as spraying, and harvesting easy for some VMGs. • Opportunities for some of the VMGs who become self-employed as service providers in spraying and pruning • Mechanical pruning can be a new frontier for women

E: Case studies/profiles of success stories	
Success stories	• *Increased uptake of the KALRO mango rehabilitation technology by farmers in Tana-River, Kwale and Kilifi counties* • *Technology adoption among* private players and NGOs is increasing
Application guidelines for users	Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). Mango Propagation
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Industrial Crop Research Institute, Mtwapa F.N. Pole, F.K. Muniu, M. Menza, S. Mwashumbe
Partner organizations and contacts	Pwani University, info@pu.ac.ke.S. Muti; H. Saha. Coast Development Authority, J. Kombe

2.4.7 Plant Spacing

2.4.7 TIMP Name	Plant Spacing
Category (technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity
What is it? (TIMP description)	This is the establishment of mango orchards at recommended optimal spacing of 12 m x 12 m in CL3, 10m x10 m in CL4.  
Justification	Low productivity of mango trees as a result of random planting of seedlings and at closer spacing results in overcrowding and intermingling of canopy. This leads to poor light penetration and difficultyin undertaking management practices such as pruning and weeding. Overcrowding also increases spread of pests and diseases as well as competition for nutrients. Low plant spacing also results in sub optimal production. Observing recommended plant spacing ensures optimum crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Mango growers, Public and private extension service providers, Researchers and agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Skilled extension service providers; • Availability of improved Mango varieties • Funding to promote the technology • Methods of promotion
Partners/stakeholders for scaling up and their respective roles.	• County Governments to provide Extension workers for mobilization and sensitization of farmers • NGOs to upscale the technology with farmers, • Private extension service providers to provide services to the farmers at a fee • KALRO - to establish demo farm and provide technical backstopping
C: Current situation and future scaling up	
Counties where already promoted. if any	Kilifi, Kwale, Tana River and Lamu
Counties where TIMPs will be upscaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination	• Inadequate extension service providers • Land ownership challenges
Suggestions for addressing the challenges	• Training growers and service provides • Encourage more participation of NGOs/private partnerships • Support improved extension services • Campaign for attitude change
Lessons learned in up scaling, if any	• Availability of cost benefit information enhances adoption • Technology does not require high resources for its use
Social, environmental, policy and market conditions necessary for development and up-scaling	• The technology is socially acceptable and appropriate • Availability of market to take up the produce at competitive prices • Favourable weather conditions • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Neglibible Costs for string and tape measure for field lay out are minimal
Estimated returns	a) Cash returns: One 8 years old tree yields >300 of raw mangoes @ KES 20 = KES 6,000 per tree per season. Over crowding realizes less mangoes per tree; too wide spacing results in fewer trees per area of land
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land, credit,and quality seeds than men • Women and youth have limited access to education, training and extension services than men • mango trees are considered men's enterprises thus limiting women control and benefit from them • Men dominate decision making on mango at the household and community
Gender related opportunities	• The technology can be easily adopted by women and youths as it not laborious

	• Spacing optimizes production hence optimized returns and improved household incomes to the benefit of women
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 information on new varieties and production techniques
VMG related opportunities	• Opportunities for employment exist for youths as service providers in new orchard establishment activities. • Mechanization of the practice
E: Case studies/profiles of success stories	
Success stories	• Increased productivity among growers who adopted the practice in Kilifi, Kwale and Lamu Counties
Application guidelines for users	• Growers' Manuals and leaflets
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Mtwapa; P.O. Box 16-80109. Mtwapa Phone: 020-2024751 Kalro.Mtwapa@kalro.org
Lead organization and scientists	KALRO: F. Pole, F. Muniu, M. Menza, S. Mwashumbe
Partner organizations and contacts	Pwani University, info@pu.ac.ke.S. Muti; H. Saha. Coast Development Authority, J. Kombe

Gaps

1. Validate spacing recommendations in new growing areas (Tharaka Nithi)

2.4.8 Maturity indices

2.4.8 TIMP name	Maturity indices
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Postharvest losses due to harvesting of immature and/ or over mature mango fruits. Pre-mature mangoes will rot and become unpalatable to the consumers while over ripe mangoes will have a shorter shelf life.
What is it? (TIMP description)	Maturity indices is a set of physical, physiological, biochemical and subjective parameters used to determine whether a fruit is ready for harvesting, based on the target market or use. The physical

	parameters include color, size, and firmness whilephysiological parameters include ethylene evolution and respiration rate. Biochemical parameters on the other hand include total soluble solids, titratable acidity whereas ubjective indices include shoulder and nose shape.
Justification	Inappropriate harvest maturity (over mature or immature) results in high postharvest losses since the fruits cannot be used for the intended purpose or fail to meet the quality standards for the target market and hence rejected. If such fruits are used, the processed products also fail to meet the quality standards and therefore are rejected or shunned by consumers. Therefore, fruits must be harvested at the right stage for the target market and use. The use/application of maturity indices ensures minimal crop loss and harvest of quality crop that meets the market demand.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, a traders, Extension service providers, processors, Researchers and Agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals. • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Market demand for quality fruits • Funding to promote the practice • Methods of promotion
Partners/stakeholders for scaling up and their roles	• CBOs and NGOs - mobilization of farmers • National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and mobilization of farmers for public awareness • Farmers/farmer groups- adopt, test and validate the new technology • KALRO - undertake adaptive research on current and other new varieties, avail quality planting material and offer technical support
C: Current situation and future scaling up	
Counties where already promoted, if any	• Makueni, Embu,Machakos, Meru, Kilifi, Kwale, Tana-River
Counties where TIMP will be up scaled	• All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Inadequate resources for dissemination activities

	• Local market has not fully embraced quality as a parameter for value determination • Few or no extension service providers • Lack of mango innovation platforms to facilitate interaction with relevant stakeholders
Suggestions for addressing the challenges	• Avail resources for dissemination activities • Create consumer awareness to appreciate quality produce • Sensitize mango harvesters on maturity indices for various market outlets. • Enhance provision of extension services
Lessons learned in up scaling, if any	Farmers have their own parameters that they use to determine maturity indices which must be taken into consideration when training them on subjective indices of maturity.
Social, environmental, policy and market conditions necessary for development and upscaling	• Market based maturity indices will be acceptable to target communities • The growing environments will be suitable for effecting the indices • Market availability and demand for quality fruit • Appropriate policies that will reward farmers who deliver quality mango produce to the market by observing maturity indices. • Favourable regulation on site specific harvesting of mango
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	Not yet determined
Gender issues and concerns in development and dissemination Gender issues and concerns in adoption and scaling up	• Women have limited access to information than men • The practice suites the youth who are mainly engaged inharvesting • The practice may not favour women especially harvesting from tall trees • Women are less involved in making key decisions related to harvesting of mangoes.
Gender related opportunities	• Offers employment to active youth, in harvesting actities
VMG issues and concerns in development and dissemination	• VMG are rarely involved in information dissemination fora • The practice may not favour VMGs as harvesting requires fit and agile persons
VMG related opportunities	May offer employment to some VMGs in harvesting activities and fruit sorting for different market needs
E: Case studies/profiles of success stories	
Success stories from previous projects	• The practice has been adopted in Embu and Makueni , where farmers have improved the quality standards of fruits delivered to the market
Application guidelines for users	Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation*
F: Status of TIMP readiness (**1.** Ready for upscaling; **2.**	1. Ready for up scaling

Requires validation; **3.** Requires further research	
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751 OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO-Horticulture Research Institute, Kandara, Pole F.N, Charity Gathambiri,Njuguna J, Wanjala W.N.
Partner organizations	KALRO, ICRAF, UoN.

2.4.9 Conservation Agriculture

2.4.9 TIMPs name	**Conservation Agriculture**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Declining land productivity due to soil degradation which is characterised by increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	Conservation agriculture is an approach to farming that follow key principles targeting to conserve the soil, soil moisture, soil-nutrients, and stabilize land production while reducing on the cost of production Conservation agriculture principles include: Minimal soil disturbance, • Maintenance of permanent ground cover - a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), • Crop rotation or sequences and associations of crops including trees, which include nitrogen-fixing legumes.
Justification	Reduced yields due to decreasing land productivity occasioned by land degradation is a leading cause of low resilience especially in the ASAL areas. Conservation agriculture (CA) has potential to: • Enhance soil fertility and organic matter content, and improve the efficiency of nutrient inputs, thus enabling increased production with proportionally less fertilizer; • Contribute to optimum plant growth without increasing GHG emissions induced by excess fertiliser use, through crop rotations and associations that include nitrogen-fixing legumes;

	• Minimizes the net loss of carbon dioxide by microbial respiration and oxidation of the soil organic matter and builds soil structure and bio- pores through soil biota and roots • Shields the soil surface from heat, wind and rain, keeping the soil cooler and reducing moisture losses by evaporation through the protective soil cover of leaves, stems and stalks from the previous crop • Help to reduce soil compaction and plough pans and regenerates degraded lands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers (Women, Youth, and VMGs), extension service providers, researchers and agriprenuers.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings- workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Most effective approach	• FFBS, Mass and social media and extension services.
Critical/essential factors for successful promotion	• Training on principles and benefits of CA • Enhanced PPP model to support and showcase conservation agriculture with agro-forestry • Funding to promote the practice • Establish model or demo farms
Partners/stakeholders for scaling up and their roles	• National and County county Extension officers - Dissemination of information, capacity building • CBOs, NGO's (African Conservation Network, One Acre Fund) and Donors- Capacity Building, Dissemination of information and financial support • CIAT, FAO – capacity building • Ministry of Agriculture and Livestock Development and County department of Agriculture – development of enabling environment and supportive policies, Funding of CA activities and capacity building, • KALRO – establishing demo farms, offering extension services and technical backstopping
C: Current situation and future scaling up	
Counties where technology is already promoted if any	Meru, Embu, Laikipia, Bungoma, Kakamega
Counties where TIMPS will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• Non-availability of crop residue in suitable quantities, for demonstrations • Limited knowledge on the incremental benefits of CA • Inadequate CA implementors • Few or no extension service providers • Wrong or negative perception towards the practice
Suggestions for addressing the challenges	• Avail funding for procurement of crop residue for demos • Improve KALRO and county government capacity to train and re-tool technical teams so as to enhance disemination • Allocation of more funds for acquisition of equipment. • Enhance provision of extension services • Advocate for attitude change
Lessons learned in up scaling	• Uptake of CA technology increases with the realized incremental benefits over time • Continuous capacity building increases uptake of CA technology
Social, environmental, policy and market conditions necessary	• TIMP will be acceptable to the target communities • The growing environment will be suitable for the implementation of the TIMP i.e Favourable weather conditions • Market will be available to absorb the extra yields • Favourable policies to support the practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Varies depending on the intervention put in practice
Estimated returns	Increased productivity per unit area
Gender issues and concerns in development, dissemination, adoption and scaling up	• CA with trees is a technology that can be easily adopted by women and VMGs • Reduces labor demands across all genders • Women and Youth are usually left out decision making thereby reducing their uptake of the practice • Limited access and control of resources such as land especially among women to implement the practice
Gender related opportunities	• The practice leads to improved production offering food security and improved income to the household. • Minimum tillage saves on cost of production
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs are usually left out of decision making thereby reducing their uptake of the practice • Limited access and control of resources such as land especially among women
VMG related opportunities	Reduced labour requirement is for the benefit of the VMGs
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Farmers and agro-pastoralists who have adopted the technology have had sustainable source of income and increased resilience
Application guidelines for users	References 1. Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents In Kenya. 2. Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual

	3. SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi
F: Status of TIMP (1. ready for up scaling 2, Requires validation 3. Requires further research)	1.Ready for upscaling
G: Contacts	
Contacts	NRM Team: Mwaura J., Kamau D., Esilaba A., Ketiem P., Mutuma, Kasina M, Njuguna
Lead organization and scientists	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Partner organizations	KALRO, Universities, MoALD and County Department of Agriculture and Private Public Partners

GAPS

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

2.5. Soil Fertility Management

2.5.1 Integrated Manure Management (IMM)

2.5.1 Technology name	**Integrated Manure Management (IMM)**
Category(technology,innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health. Poor manure management and handling leads to increased Green House Gases (GHG) emissions
What is it? (TIMP description)	• Integrated Manure Management (IMM) is the practice of optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops
Justification	• The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. The estimated nutrient losses due to soil erosion, leaching and crop harvests are sometimes over 60-100 kg of Nitrogen (N), Phosphorus (P) and Potassium (K) per hectare per year. Manure plays an essential role in the nutrient cycle wherein crops and fodder grown on land are fed to livestock, which in turn feeds

	the soil with their manure. Managing manures to improve quality enhances the efficiency of crop production, and reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility through the supply of macro and micro nutrients. Well managed manure also improves soil health that leads to increased agricultural productivity, improved soil structure and below-ground biodiversity. • Given that mineral fertilizers have become expensive, and out of reach for ordinary farmers, manure has the potential of providing the limiting nutrients and improving the soil health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Agriprenuers, Extension service providers and Researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media - Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms - Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Training on preparation, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using mango • County and National government support • Funding to promote the practice
Partners/stakeholders for scaling up and their roles	• Ministry of Agriculture and Livestock Development and County department of agriculture – provide extension services, farmer mobilization and policy formulation • KALRO and ILRI - technical backstopping • CBOs, NGO's (African Conservation Network, One Acre Fund) and Donors- Capacity Building, Dissemination of information and financial support
C: Current situation and future scaling up	
Counties where already promoted if any	Kajiado, Uasin Gishu, Tharaka Nithi
County where TIMP will be promoted	All the mango growing counties

Challenges in dissemination	• Lack of model demonstration farms • Cultural challenges – mango training in ASAL communities is mainly received by females but the males are the key on-farm decision makers • Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration plots by counties • Capacity building of ASAL communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of relevant 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 collection, preparation, storage and application are key in mango farming • Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions
Social, environmental, policy and market conditions necessary for development and up scaling	• Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbor pathogens which can cause disease outbreaks to mango • Contamination of water sources by leaching of nutrients • Favourable policies to support adoption • Favourable weather conditions • Favourable policies to support seed/production, regulation, marketing and value addition.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Purchase of one-acre equivalent manure-load (including transport costs) @ KES. 14,000/= • Labor for application @ KES. 6,000/= per acre
Estimated returns	• Based on the response crop (can lead to over 100% increase of total revenue from the sale of the improved crop)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to farm inputs such as manures than men • Women have less access to information, technology and knowledge on manure • Women and youth have limited access to education, training and extension services than men • Men dominate decision making in most of the household.

Gender related opportunities	• Women and youth can have opportunities in manure application and earn an extra income • Improved food and nutrition security for women • The practice leads to increased production offering sustainable livelihoods for women • Job opportunities in composting
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to farm inputs such as manures than men • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded in decision making and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Unemployed youths can have opportunities in manure management and application that earn them extra income
E: Case studies/profiles of success stories	
Success stories	• Farmers who have adopted manure management practice have reported improved soil health and increased crop yield and hence sustainable source of income
Application guidelines for users	Sanginga, N., & Woomer, P. L. (Eds.). (2009). Integrated soil fertility management in Africa: principles, practices, and developmental process. CIAT.
F: Status of TIMP readiness(1=Ready for upsacling: 2=Requiresvalidation; 3=Requires further research	2 = Requires validation
G: Contacts	
Contacts	The Director, Natural Resource Management KALRO – Secretarial P.O. Box 57811-00200, **Nairobi** Email: director.nrm@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	KALRO, MoALD, County Department of Agriculture and Private Public Partnerships

Gaps

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

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

2.5.2 Integrated Soil Fertility Management (ISFM)

2.5.2.TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Reduced yields, declining soil fertility and low organic matter.
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 in combination to adapt practices to local conditions. It places emphasis on the importance of efficient use of the often scarce resources like fertilizer and organic inputs through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence).
Justification	• Soils within the farming systems are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. • A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. • These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension service providers, Researchers and Agri-prenuers

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and • Production resources (land, money, labour, crop residues) that different farming families are able to invest in. • Methods of promotion
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers. • Community farmer groups (CBOs); coordination of problem identification and dissemination. • Financial institutions- Provide credit facilities • KALRO – establishment of demo farm, extension services and technical backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
County where TIMP will be promoted	All KCSAP counties
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Misconceptions that chemical fertilizers damage the soils • Inadequate extension service providers
Suggestions for addressing the challenges	• Training and awareness on the benefits of of organic manures in crop cultivation • Training and awareness creation on the importance of fertilizer applications to clear the misconceptions about fertilizers • Training on use of manures in combination with modest amounts of mineral fertilizers

Lessons learned if any	For ISFM to succeed, good or certified germplasm/seed/seedlings, among others is required since farmers tend to re-use previous planted materials
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Favourable and supporting policies to support adoption of ISFM practices • Favourable weather conditions • Market availability for increased productivity
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on choice of the technology options integrated as influenced by the basic input costs
Estimated returns	• Increased farm level income by >50%.
Gender issues and concerns in development, dissemination adoption and scaling up	• The practice integrates participation of male and female gender roles during field activities. • Female gender is disadvantaged when application of heavy loads of manure are to be incorporated in the field. • Adoption and scaling up of ISFM technologies could be affected by the ownership of the farm that are mainly male owned where the man does not own the technology • Limited access to extension services and trainings among women and youths
Gender related opportunities	• Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that save on the cost which is good for all gender in the farm household. • There is increases employment for the youth • Increases food security and nutrition for households
VMG issues and concerns in development, dissemination adoption and scaling up	• Limited access and control of resources such as land especially among women limits their adoption of technology. • Limited access to extension services limits their adoption • Limited access to credit facilities for purchase seed and fertilizers as required for successful implementation of the practice • VMGs are physically disadvantaged for a practice that seeks to incorporate manures in the farm
VMG related opportunities	The technology if well-practiced can increase farm incomes of VMGs by up to 50%. The technology can improve food security and nutrition of the VMGs
E: Case studies/profiles of success stories	
Success stories	• Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by over 50 percent • ISFM has resulted in improved productivity of maize in Mtwapa.

Application guidelines for users	Sanginga, N., & Woomer, P. L. (Eds.). (2009). Integrated soil fertility management in Africa: principles, practices, and developmental process. CIAT.
F: Status of TIMP readiness (1=Ready for upsacling: 2=Requires validation; 3=Requires further research	1 =Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: C. Ondiko, B. Muli,A.Mzingirwa, E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa
Partner organizations and contacts	KALROMoALD and County Department of Agriculture, KEFRI, NGOs

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 Rapid soil testing services

2.5.3. TIMP name	**Rapid soil testing services**
Category(technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Expensive and timetaking conventional soil testing methods
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.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to rapid soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use. Rapid soil testing is therefore an alternative method for determining nutrient status and making appropriate and timely recommendation.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers, Researchers and Agriprenuers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion.	• 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 skilled 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 of 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	• National and County Ministry of Agriculture and Livestock Development – policy development, Extension services and providing the link to farmers • ICRAF and ISDA - tests and validates the recommendation obtained in collaboration with KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers. • Financial institutions- Provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted	Technology has not been promoted though testing has been ongoing in a few counties
Counties where TIMP will be up scaled	All 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 • Lack of validation of the scanners

	• High cost of scanners
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. • Automated pipelines for updating existing recommendation methods. • Validation of the scanners before recommending for adoption
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	• Market availability for increased productivity • Favourable policies to support the adoption of technology • Favourable weather conditions
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• The cost of analyzing one soil sample still remains @ KES. 1,000/=. • Transaction costs for collecting soil samples (by experts including their transport costs) and dispatch may average to KES. 1,250/=. However, since more than one sample must be collected (a minimum of six samples per farm), the average cost of a sample can be estimated at KES. 7,500/= for an average farm of 3-5 acres. • Note: the number of soil samples is largely influenced by the degree of soil type variability of the farm
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have limited access to credit to pay for the services than men • Women have less access to information, technology and knowledge • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	Rapid testing method offers employment opportunities to tchno-compliant youth and women

VMG issues and concerns in development, disseminationadoption and scaling up	• VMGs have less access to farm inputs such as credit to pay for the services than men • VMGs have less access to agricultural information, technology and knowledge on soil testing • VMGs have limited access to productive resources such as land, credit and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness or involvement
VMG related opportunities	Offers employment especially for the youth who could be trained as soil sampling and testing champions to offer services to the local communities
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	• Dimkpa, C., Bindraban, P., McLean, J. E., Gatere, L., Singh, U., & Hellums, D. (2017). Methods for rapid testing of plant and soil nutrients. Sustainable agriculture reviews, 1-43.Okalebo, J. R., Gathua, K. W., & Woomer, P. L. (2002). Laboratory methods of soil and plant analysis: *a working manual second edition.Sacred Africa, Nairobi, 21, 25-26.*
F: Status of TIMP readiness (1=Ready for upsacling: 2=Requiresvalidation; 3=Requires further research	2= Requires validation
G: Contacts	
Contacts	The Director, Natural Resource Management KALRO – Secretarial P.O. Box 57811-00200, **Nairobi** Email: director.nrm@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: C. Kibunja, A. Sila,D. Kamau, A.O. Esilaba
Partner organizations and contacts	KALRO, County governments in the 24 counties, ICRAF

Gaps:

1. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
2. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities as per farmer needs.
5. Develop and validate appropriate scanners for use at farm level to undertake fertilizer quality analysis, including 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 Contour bunds

2.5.4 TIMP name	**Contour bunds**
Category (technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff; low soil water retention capacity in most soils
What is it? (TIMP description)	Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and run-off 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 (the arid and semi-arid lands, ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs.The aim of contour bunds is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping runoff water from the catchment area between them. This also decreases the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas cereal crops requiring less water, such as mango or millet, can be planted on the ridges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, Extension service providers and agripreneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• 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
County where TIMP will be promoted	Kilifi, Murang'a, Kitui, Embu, Kajiado, Kwale, Tana River, Makueni
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 bunds 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/titling

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. • 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 necessaryfor development and upscaling	• 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. However, the current market rates/cost of KES. 450/= per day holds
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
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	• Potential for employment creation for youth who can 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 • Competing priorities and household decisions might hinder adoption and scaling up
VMG related opportunities	• Potential for employment creation for unemployed youths and VMGs who can provide labour during the implementation of the technology
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 terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed it into the river and the maize grew short. But when we made terraces the soil erosion stopped and we got good crops"
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF).
F: Status of TIMP readiness 1. Ready for upscaling; 2=Requiresvalidation; 3=Requires further research	1 Ready for upsacling
G: Contacts	
Contacts	The Centre Director KALRO Kabete, E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations and contacts	County Governments extension offices.

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

2.5.5 Zai Pits

2.5.5. TIMP name	**Zai Pits**
Category(technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Unreliable water to sustain a crop as a result of high seasonal rainfall variability leading to total crop failures. Decreased yields leading to food insecurity.
What is it? (TIMP description)	Zai Pits are planting pits typically measuring 15-30 cm in width, 10-20 cm deep and spaced 60-80 cm apart. Zai Pits harvest and stores water for prolonged crop use. Farmers plant into the pits after filling one to three handfuls of organic material such as manure, compost, or dry plant biomass. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs). For mango, the pits will be modified.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Zai Pits technology has the potential to harvest and store rain water for prolonged crop use. This technology also contributes to improving the management of degraded lands, reducing soil erosion, vegetation loss and biodiversity as well as mango yield.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, Extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct Zai pits. • Availability of affordable organic matter (manure, compost).
Partners/stakeholders for scaling up and their roles	• County government extension services –delivery of information inputs to farmers. • Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools • NGOs – capacity building, policy support in soil and water conservation issues
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
County where TIMP will be promoted	Kilifi, Murang'a, Kitui, Embu, Kajiado, Kwale, Tana River, Makueni
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement at large scale.
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of Zai pits for efficiency and increased output per man hour. • Training youthful farmers to be champions of Zai pits construction at the Ward level/village level.
Lessons learned, if any	The technology has huge potential to increase farmers' resilience especially in ASALs. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 • Provide support in the establishment of the Zai pits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for Zai pit preparation. It is estimated at KES 40 to 100 per Zai Pit
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development,dissemination, adoption and scaling up	• The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge

	• Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community level
Gender related opportunities	• Potentialto create employment for youththrough provision of the labour required
VMG issues and concerns in development,dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG issues and concerns in adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Potentialto create employment for youththrough provision of the labour required
E: Case studies/profiles of success stories	
Success stories, if any	Two women groups in Kiliki, Matungulu sub-County of Machakos County through a representative Janet Ndunge reported having started using the Zai pit farming technology in 2013 after attending a farming workshop by the Institute for Culture and Ecology (ICE).“Ever since we started using Zai pits, we have seen an increase in our harvests as compared to the conventional methods of farming,” she said. Farmers in Kathonzweni, Makueni County increased dug pits from 170 to 500 pits for crop production due to initial observed benefits.Communities in ASALs have also rehabilitated degraded lands and increased production by many folds.
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF).

F: Status of TIMP readiness 1. Ready for up scaling, 2=Requiresvalidation; 3=Requires further research	1.Ready for up scaling
G: Contacts	
Contacts	The Centre Director, KALRO Kabete E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Ketiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations and contacts	County Governments extension offices.

Gaps:

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

2.5.6 Bench Terraces

2.5.6. TIMP name	**Bench terraces**
Category(technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff; 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 throughbench terracing enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for semi-arid to humid regions with 700 mm or more rainfall, medium to steep slopes (12- 47%) (bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.

Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya. This practice is suitable for slopes greater than 12%
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, Extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• 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
County where TIMP will be promoted	Kilifi, Murang'a, Kitui, Embu, Kajiado, Kwale, Tana River, Makueni
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. • 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 for development and upscaling	• 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. However, the current market rates/cost of KES. 450 per day holds
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Bench terrace technology is labour intensive therefore may increase women work burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community levels
Gender related opportunities	• Potential to create employment for youththrough provision of the labour required

VMG issues and concerns in development and dissemination	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to productive resources such as land, credit, and quality seed • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is lowadoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for youths exists in provision of labour
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 It into the river and the maize grew short. But when we made terraces the soil erosion stopped and we got good crops."
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF)
F: Status of TIMP readiness 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	1 Ready for upsacling
G: Contacts	
Contacts	The Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel:+254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations and contacts	KALRO, County Governments extension offices.

2.5.7 Fanya Juu Terraces

2.5.7 TIMP name	Fanya Juu Terraces
Category (technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff; low soil water retention capacity in most soils
What is it? (TIMP description)	'Fanya juu' terracesare constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as bananas, pawpaws, citrus and guava, are grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off. The technology is highly suitable in low annual rainfall areas (less than 700 mm); moderate slopes (less than 20%); deep soils (more than 60 cm); and hilly areas that are subject to widespread erosion.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, Extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• 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
County where TIMP will be promoted	Lamu
Challenge(s) in development and dissemination	• Increased risk of soil erosion if terraces are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of terraces for efficiency and increased output per man hour. • Training youthful farmers to be champions of 'fanya juu' terraces construction at the Ward level/village level. • Training on site specific designs and construction of 'fanya juu' terraces • Fast-track land registration
Lessons learned, if any	• 'Fanya juu' terracing is popular due largely to the rapid benefits it gives in terms of soil and water conservation. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • 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 for development and upscaling	• 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 terrace preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men make key decisions most decisions at the household and community levels
Gender related opportunities	• Potential to create employment for youth through provision of the labour required
VMG issues and concerns in development	• The technology is labour intense and may be difficult for the VMG to implement in the field.
and dissemination	• 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 • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for unemployed youth exists in provision of labour
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in lower Eastern counties of Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runoffwater and soil.
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF).
F: Status of TIMP readiness 1. Ready for up scaling,	1 Ready for up scaling

2=Requiresvalidation; 3=Requires further research	
G: Contacts	
Contacts	Centre Director, KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations and contacts	County Governments extension service

2.5.8 Stone lines

2.5.8. TIMP name	**Stone lines**
Category (technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff; low soil water retention capacity in most soils
What is it? (TIMP description)	Is a soil and water management option where stones are placed along contour lines to slow down runoff. With time, the soil builds up on the upslope side of the stone line and a natural terrace is formed. The technology is suitable in gentle to

	moderate slopes (less than 10%); areas with low annual rainfall areas (200 - 750 mm); and stony areas
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Stone lines can help in the conservation of soil and moisture.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct stone lines. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	• County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – provide on farm demonstration plots to hold farmer field schools; provide collective labor. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
County where TIMP will be promoted	Machakos
Challenge(s) in development and dissemination	• Increased risk of soil erosion if stone lines are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds

Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools for preparation and laying of stones lines for efficiency and increased output per man hour. • Training youthful farmers to be champions of laying stone lines and maintenance. • Training on site specific designs and laying of stone lines Fast-track land registration
Lessons learned, if any	• Existence of well-developed self-help groups can lead to successful construction of stone lines. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary for development and upscaling	• 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	For each hectare, transport and other project costs amount to around KES 25,000.
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men dominant most decisions at the household and community levels
Gender related opportunities	• Potentialto create employment for youththrough provision of the labour required
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • The VMGs may not be able to do the works due to theirsituation • VMGs have limited access to productive resources such as land, credit, and quality seed • VMGs have limited access to training and extension services

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for youth exists in provision of labour
E: Case studies/profiles of success stories	
Success stories, if any	In Burkina Faso farmers have reported doubled cereal production when stone lines are used in combination with greater use of compost as fertilizer. https://www.rural21.com/fileadmin/_migrated/content_uploads/Stone_lines_against_desertification_01.pdf
Application guidelines for users	
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requiresvalidation; 3=Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRO Kabete P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba
Partner organizations and contacts	County Governments extension service, NGOs.

2.5.9 Retention ditches

2.5.9 TIMP name	Retention ditches
Category(technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff
What is it? (TIMP description)	Retention ditches are trenches designed to catch and retain incoming runoff and hold it until it infiltrates into the ground. They can be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The technology is suitable in semi-arid areas, in permeable, deep and stable soils and on flat or gentle sloping land
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, Extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct stone lines. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	• County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – provide on farm demonstration plots to hold farmer field schools; provide collective labor. • External service providers – capacity building and access to technology

C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
County where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenge(s) in development and dissemination	• Increased risk of soil erosion if retention ditches are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools for digging out retention ditches for efficiency and increased output per man hour. • Training youthful farmers to be champions of digging out retention ditches. • Training on site specific designs and layout • Fast-track land registration
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary for development and upscaling	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for digging retention ditches as dictated by the land size and the landscape terrain/slope. A current market price of labor of KES. 450/= per man-day applies
Estimated returns	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men dominate in makingmost decisions at the household and community levels
Gender related opportunities	• Potentialto create employment for youththrough provision of the labour required

VMG issues and concerns in development and dissemination	• 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 • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Application of retention ditch ridge is expected to improve agriculture production thus, more food and income for the VGMs. • It offers potential for youth employment
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Eastern and Central Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of retention trenches in hillside to trap runaway water and soil.
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF).
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requiresvalidation; 3=Requires further research	1 Ready for upscaling
G: Contacts	
Contacts	Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel:+254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations and contacts	County Governments extension service

2.5.10 Grass Strips

2.5.10 TIMP name	Grass strips
Category(technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased runoff
What is it? (TIMP description)	Grass strips are dense strips of grass planted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively 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, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• 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
County where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
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 used as mulch for crops by farmers.
Social, environmental, policy and market conditions necessary for development and upscaling	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labor 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	This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limited ownership of or access to land may limit women from technology implementation • Limited power in making decisions on land use may limit women in technology adoption

	• The technology is labour intensive and may limit implementation by women • Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up. • Limited access to appropriate tools and credit may limit application of technology among specific gender including women
Gender related opportunities	• There is potential for application for mechanization creating youth employment • Mechanization will make the work easy enabling women participation
VMG related opportunities	• There is potential for application for mechanizationcreating youth employment
E: Case studies/profiles of success stories	
Success stories, if any	Farmers have reported improved reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice
Application guidelines for users	A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICRAF).
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requiresvalidation; 3=Requires further research	1 Ready for upsacling
G: Contacts	
Contacts	Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel:+254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba
Partner organizations and contacts	County Governments extension service

2.5.11 Tied ridges /Ridging / Earthing

2.5.11 TIMP name	Tied ridges /Ridging /Earthing
Category (technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop water stresses in production; Increased water losses in the furrows
What is it? (TIMP description)	Tied ridges are small earthen ridges, 30 cm high, with an upslope furrow which accommodates water between the ridges. The technology consists of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones. Water is applied to the top end of each furrow and flows down the crop field under the influence of gravity.
Justification	With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges help conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.
Region promoted	Tana River, Garissa, and West Pokot counties
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Proximity to water sources -close to permanent water sources • Suitable topography of area (level land) • Technical capacity for maintenance

Partners/stakeholders for scaling up and their roles	• County government – capacity building • Private sector – access to credit, capacity building • NGOs (Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM) – capacity building, credit facilities, facilitate technology access • National Irrigation Authority– technology access and capacity building • Water Resources Management Authority – Water resources use management
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
County where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Can be labour intensive during establishment phase • Poor management may lead to water use inefficiencies • Limited access to credit may limit uptake • Land tenure insecurity in some counties limits adoption and investments
Recommendations for addressing the challenges	• Enhancing farmers' capacity to see benefits • Enhance access to credit • Implement policy on land use and tenure
Lessons learned	• Use of tied ridges with furrow irrigation significantly increases yields • Poor management and designs may often result in flooding of low areas • Assessment of soil erosion and sediment is key to • sustainability
Social, environmental, policy and market conditions necessary for development and upscaling	• The economics of furrow irrigation needs to be well articulated • Enhanced land quality control to mitigate against soil salinity • Adequate policies and guidelines regarding water abstraction from the main water sources to minimize resource conflicts especially along river downstream. • Market for the crops produced under irrigation should be identified early enough to minimize losses and increase profitability from the system
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Not known (Research gap)
Estimated returns	• To be established in the longer-term 3-5 years at mango maturity

Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	Potentialto create employment for youththrough provision of the labour required
VMG issues and concerns in development and dissemination	• 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 • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Opportunities exist for youth exists in provision of labour
E: Case studies/profiles of success stories	
Success stories	There are successful models for such technology (Mwea and Perkerra irrigation schemes) where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	1. Sijali I V. Drip irrigation: options for smallholder farmers in Eastern and southern Africa. 2001. RELMA Technical Handbook Series 24. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency (SIDA). 60 p. + x p.; includes bibliography 2. FAO CSA Manual 3. FAO Irrigation Water Management: Irrigation Manual 4. GoK MoALF: Training Manual for Water Users Association and farmers
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	1. Ready for upscaling

G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: J. Mwaura, I. Sijali
Partner organizations and contacts	National Irrigation Authority (NIA), Water Resources Management Authority

Gap:

1. The economic viability of the technology in different agro ecological zones needs to be determined

2.5.12 Rain water harversting systems (roof catchment)

2.5.12 TIMP name	Rain water harvesting systems (roof catchment)
Category(technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed:	Water scarcity for agricultural use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. Storm water is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage. By collecting, storing and utilizing water for agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting 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	Farmers, pastoralists and agro-pastoralists, research service providers, extension service providers and agripreneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• 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 at household level.
County where TIMP will be promoted	Kilifi, Murang'a, Kitui, Embu, Kajiado, Kwale, Tana River, Makueni

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.

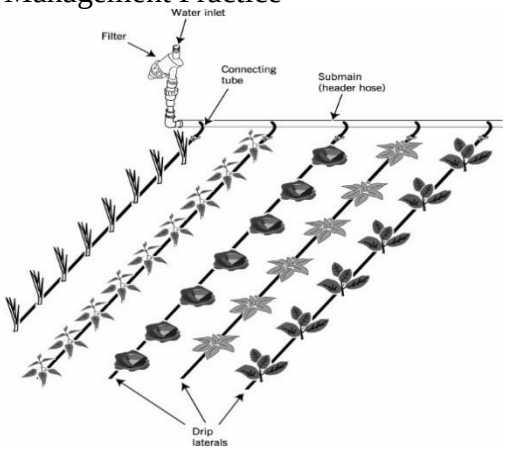
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training programs water harvesting technologies, maintenance and operation skills • Cost 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	• Devise systems that are gender sensitive – target different gender needs • Carry out environment and social impact assessment of the technology in specific Counties and cultures • Support structures that help access to credit for technology access and maintenance • Enact policy frameworks to support water harvesting • Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Not determined (research gap existing) • Not affordable to most rural households.
Estimated returns	• This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years
Gender issues and concerns in development and dissemination	• Men dominate most decisions at the household and community levels • The technology is labour intensive therefore may increase women labour burden • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women have limited access to education, training and extension services than men
Gender related opportunities	• Potential to reduce women work burden in fetching water so that they can perform other productive tasks
VMG issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive and may limit implementation by VMGs • VMGs have less access to agricultural information, technology and knowledge • VMGs have financial constraints • VMGs have limited access to productive resources such as land, credit, and quality seed • VMGs have limited access to training and extension services

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for youths in provision of labour for the TIMP
E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square 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	• Handbook on Rainwater Harvesting and Storage Options • Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F. Status of TIMPS readiness 1) Ready for up scaling; 2) Requires validation; 3) Requires further research	1 Ready for up scaling
G: Contacts	
Contacts	KALRO NRM Team: Mwaura J., Kamau D., Esilaba A., Ketiem P., Mutuma E, Kasina M.
Lead organization and scientists	KALRO NRM
Partner organizations	County government, Public-Private Partnerships

Gaps:

1. Development of models of rainwater harvesting for intensive agricultural production and household use.
2. Working with locals to identify centralized location where to establish communal earth dams.
3. Researching for cheaper technologies for water storage structures at the farm level
4. Quantifying economic returns of different water harvesting systems or technologies in the ASALs

2.5.13 Drip irrigation systems for small scale farmers

2.5 .13 TIMP name	Drip irrigation systems for small scale farmers
Category(technology, innovation or management practice)	Management Practice  Layout of a drip irrigation system in vegetables
A: Description of the technology, innovation or management practice	
Problem to be addressed	Increased crop water stress caused by seasonal rainfall variability in rain-fed production.
What is it? (TIMP description)	The technology that supplements water in crop production systems. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. The system provides efficient fertilizer usage (fertigation) with irrigation water
Justification	The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. Mainstreaming drip irrigation systems into crop production provides the opportunity for farmers to enhance crop resilience, increase yields and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Model farmers, research service providers, Extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Correct field design (system installation) of the drip system to minimize water inefficiencies.Training of farmers and extension • Drip management skills
Partners/stakeholders for scaling up and their roles	• County governments; capacity building, supportive policies and frameworks • Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Bomet, Kajiado, Machakos
County where TIMP will be promoted	Lamu
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip polytubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Recommendations for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system has also helped preserve moisture and additional nutrients to the soil • It is also important to link farmers to Micro Finance Institutions for financial needs
Social, environmental, policy and market conditions necessary for development and upscaling	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems

	• The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Two types of costs exist; investment (initial costs of equipment) and operational costs which depend on the type of value chain in question • Specifics are not in place and need to worked on
Estimated returns	• This is a long-term investment and expected returns will be realized at crop harvest within 3 to 5 years • In general, income from drip system rises by as much as 35% stemming from the management of crop water stresses. • Increased water saving means more water is available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to, credit to purchase the drip irrigation kits than men • Women have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• The technology will reduce the time burden for women who mainly fetch water for any activity including irrigation in these ASAL communities
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase the drip irrigation kits than men • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables
E: Case studies/profiles of success stories	
Success stories	There are many successful drip irrigation farmermodels across the country implemented bygovernment and other development partners. Itis noted that linking markets to crops under dripis crucial for sustainability.
Application guidelines for users	1. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi. 2. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/ai3765e.pdf 3. Palada M, Bhattarai S, Wu DL, Roberts M, Bhattarai M, Kimsan R, Midmore D. 2011. More Crops per Drop: Using

	Simple Drip Irrigation Systems for Smallscale Vegetable Production. AVRDC – The World Vegetable Center, Shanhua, Taiwan. AVRDCPublication No. 09-723. 83 p.
F: Status of TIMP readiness (1. Ready for Up scaling; 2. Requires validation; 3. Requires further research)	1 = Ready for upsacling
G: Contacts	
Contacts	Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel:+254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org OR The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO: Fabian Kaburu
Partner organizations and contacts	AMIRAN Kenya, HortiPro, SunCulture, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirtliff

Gaps:

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

2.5.14 Basin formation to enhance production in ASALs

2.5.14 TIMP name	**Basin formation to enhance production in ASALs**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Deficient and unreliable water to sustain a crop cycle as a result of high seasonal rainfall variability leading to total crop failures
What is it? (TIMP description)	A basin harvests and stores water for use by the plant and provides an area for application of nutrients. The technology is suitable for areas with unpredictable rains, especially the drought-prone areas (ASALs)
Justification	Impacts of changing climate (low and erratic rainfall) is making agricultural activities very challenging in ASALs.Basin technology harvests and stores water for prolonged use

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, research service providers, extension service providers and agripreneurs
Approachesto be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Supporting farmers with equipmentand skills
Partners/stakeholders for scaling up and their roles	County governments and NGOs
C: Current situation and future scaling up	
Counties where already promoted	Machakos, Makueni, Embu, MeruCounties
Counties where TIMPS should be up-scaled	Machakos
Challenges in dissemination	• The technology is labour intensive and many farmers find it difficult to implement due to their poverty levels.
Suggestions for addressing the challenges	• Supporting farmers with equipment • Intensive training on the technology
Lessons learned in up scaling	• Huge potential to increase farmers' resilience especially in ASALs
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmentally, it conserves water and soil erosion and generally boost biodiversity. Presently, there are no policy in place to regulate the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The labour for basin formationis estimated at KES 40 to 100each
Estimated returns	
Gender issues and concerns in development and dissemination	• The technology may be biased to male gender at the initial stages of construction of basins but once established it is utilized by both male and females • Basing on the benefit that comes after is utilizing the technologies it become easy to adopt and scaling up by both male and females • Women and youth have limited access to, credit to purchase the drip irrigation kits than men

	• Women have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge • Most dominant decisions are made by men
Gender issues and concerns in adoption and scaling up	• Opportunity for men, women and youth to generate income as a result of increased yield • Improves food security and nutrition for men ,women and youth
Gender related opportunities	• 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 • The technology may be friendly to the VMGs once they are trained on how to do it and can easily be adopted. • Lack of adequate trainers to reach out to the VMGs as well as lack of appropriate equipment for making the right basins.
VMG issues and concerns in development and dissemination	• Can be a form of employment for the youths in the VMG category. • Increased food security and nutrition for the VMG
VMG issues and concerns in adoption and scaling up	• The technology may be biased to male gender at the initial stages of construction of basins but once established it is utilized by both male and females • Basing on the benefit that comes after is utilizing the technologies it become easy to adopt and scaling up by both male and females • Women and youth have limited access to, credit to purchase the drip irrigation kits than men • Women have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge • Most dominant decisions are made by men
VMG related opportunities	• Can be a form of employment for the youths in the VMG category. • Increased food security and nutrition for the VMG
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Makueni, Machakos
Application guidelines for users	Remove the soil from the tree trunk to a depth of 60cm and a meter width
F. Status of TIMPS readiness 1) Ready for up scaling; 2) Requires validation; 3) Requires further research	Ready for up scaling

G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO; P. Ketiem, E. Mutuma, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau, I. Sijali, Njuguna
Partner organizations	NGOs , Extension

2.6. Crop Health Integrated Management of Pests and Weeds

2.6.1 Integrated Management of Mango Seed weevil (*Sternochetus mangiferae*)

2.6.1 TIMP name	Integrated Management of Mango Seed weevil (*Sternochetus mangiferae*)
Category (i.e. technology, innovation or management practice)	Management practice  Mango Seed Weevil larva (Varela, icipe)
A: Description of the technology, innovation or management practice	
Problem addressed	Up to 50% yield loss is experienced by mango farmers due to damage by seed weevil. This damage has also affected access to international markets by farmers.
What is it? (TIMP description)	Timely application of management options for this pest during fruit formation is required. The following options can be applied: • Collect and destroy all scattered fallen fruits. Chop them finely or bury them deeply (about 50 cm deep) before planting • Avoid movement of fruits from areas known to have mango seed weevils to areas where young orchards, free of seed weevil, have been established • Apply sticky bands at the upper end of tree trunks when the trees start flowering to help reducing migration of weevils to branches for egg laying

	• Remove all infested fruits and debris from the field and destroy by burning or burying 50cm deep • Spray with *Bacillus thuringiensis* at 5-20 grams per 20 litres of water • Apply banding materials such as Chlorpyrifos, Imidacloprid and grease bands (Tangle foot) at onset of flowering • Apply neem-based products (e.g. Achook, Nimbecidine) or products containing Thiamethoxam (e.g. Actara 25WG, Final Flight 25WG) or Acetamiprid (e.g. Twiga Ace 20%SL) until the fruits are about an inch in diameter (after six weeks of fruit set).  Burying under soil all infested fruits(agric.wa.gov.au)  Spraying a mango tree at fruiting stage.(Wikipedia.com)
Justification	Mango production presents an opportunity for food security, nutrition and economic empowerment of producing communities in the ASALs. Timely application of preventive measures to control/manage the pest would lead to higher yields. Mango seed weevil can cause up to 50% yield loss and hence timely application of the control measures is critical to safe yields. Farmers/producers will gain healthier and higher fruit yield for economic benefits. Burying damaged fruits enable clean-up of the environment and reduction of pest reservoir.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO to continue undertaking research in mango weevil management • PCPB to promote registration and regulate pesticides for management of the insects • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilities for farmers to purchase biological pesticides • Private pesticide companies to promote and sell registered pesticides • Change molecules so that the pest does not develop resistance
Partners/stakeholders for scaling up and their roles	• Farmers to produce • Exporters to create market pull • Extension service providers to disseminate crop information • Researchers and academia to conduct research
C: Current situation and future scaling up	
Counties where already promoted, if any	This Technology has been adopted by farmers in Embu, Machakos and Makueni counties.
Counties where TIMP will be up-scaled / Validated	• Makueni, Kitui, Baringo, Machakos, Embu, Coastal regions.
Challenges in dissemination	• Limited knowledge by farmers on Integrated Pest Management practices • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders practicing aspects of IPM
Recommendations for addressing the challenges	• Establish mango 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

Lessons learned	• Adoption of good agricultural practices by the farmers is key in management of the diseases • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Availability of credit facilities for farmers to purchase farm input will enhance the use of IPM technologies
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB to ensure insecticides sold to farmers are genuine and of high quality • Farmers willing to adopt the disease management practices • Framers are organized in groups to ensure that IPM management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1,500 for pesticides and labour per one acre of orchard.
Estimated returns	Gross margin of KES 80,000/acre at harvest of healthy fruits.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Management practice could easily be adopted by youth who become self-employed as service providers even to neighboring farms. • This practice can also be learned by women who happen to be major workers in the orchards. • Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to credit facilitiesfor them to purchase inputs • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	• Management practice could easily be adopted by youth who become self-employed as service providers even to neighboring farms. • This practice can also be learned by women who happen to be major workers in the orchards. • All willing persons would learn of the management and could even become service providers to other farms. • Create employment for the Youth- involvedas service providers
VMG issues and concerns in development, dissemination, adoption and scaling up	• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • 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 • In some cases, and depending on vulnerability status of a person, the pest management could be adoptable to some VMGs while not possible for others

VMG related opportunities	• Can create employment for VMG across the various segments of the value chain. • Local mango varieties are widely spread even in marginal areasthus the technology is relevant
E: Case studies/profiles of success stories	
Success stories	Makueni, County
Application guidelines for users	CABI Plantwise Knowledge Bank
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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Finyange Pole, David Thuranira, Miriam Otipa
Partner organizations and contacts	CABI, ICIPE, KEPHIS, FPEAK, County Governments

2.6.3 Integrated Management of Mango fruit fly (Bactrocera dorsalis; Ceratitis capitata and Ceratitis cosyra)

2.6. 2Technology name	**Integrated Management of Mango fruit fly (*Bactrocera dorsalis; Ceratitis capitata and Ceratitis cosyra*)**
Category (i.e. technology, innovation or management practice)	Management practice 
A: Description of the technology, innovation or management practice	
Problem addressed	Low yields of up to 40%and poor quality fruits. Loss of local and international markets, thus loss of incomes for farmers
What is it? (TIMP description)	The following integrated pestmanagement options will reduce the infestation of fruit flies • Maintain a hedge around the farm to conserve natural enemies and predators to reduce population of fruit flies • Weed the mango orchard frequently to destroy and remove alternate host for fruit flies

	• Prune the mango tree to open the canopy and reduce hiding sites for fruit fly • Pick the fruits early when they are semi ripened to avoid attack when the fruits became soft for the flies • Collect all infested fallen fruits around the farm into a plastic bag and destroy by burying at least 3 feet deep into the soil • Do regular scouting in the orchard and crush the maggots observed on the surface of the semi ripe or ripened fruits • Use pheromone traps such as Methyle Eugenol (ME) for *Bactrocera dorsalis* and Trimedlure for *Ceratitis* sp. • Apply beneficial mites *Hypoaspis miles* (Hypotech) at the rate of 200 mites per square meter to feed on the fruit fly pupae in the soil. • Apply *Metarhizium anisopliae* in the pheromone trap which causes plague on the fruit flies • Spray with spinosad based products such as Spinetoram or Acetamiprid such asAceta 20SP. Acetak Top 70 WG or *Lambda Cyhalothrin* (e.g. *Karate Zeon*) immediately the first fruit fly catches are noted in traps • Spot treat affected trees with poison baits of molasses with deltamethrin (Decis 2.5 EC) or bifenthrin (Brigade 25EC or defender 2.5% EC) or Buprofezin (Applaud 40% SC).  Modified fruit fly trap with volatile lure (Farmbiz.com)
Justification	Over 40% yield loss of mango fruits are being experienced in the production regions due to rotting and early fall of mango fruits. This could be prevented by trapping the flies before fruit ripening stage. Pheromone traps are commercially available and farmers need to be empowered on their use and apply the practice of management. This technology can be combined with other IPM technologies described above are effective in the management of fruit fly infestations in mango orchards.
Region promoted	
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO to continue undertaking research on use of IPM in management of fruit flies • PCPB to promote registration of pheromone traps for management of the insect and regulate theiruse • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness on IPM. • Financial institutions to provide credit facilities • Private pesticide companies to promote and sell registered pesticides only
Partners/stakeholders for scaling up and their roles	• Farmers to produce • Exporters to create market pull • Extension service providers to disseminate crop information • Researchers and academia to conduct research
C: Current situation and future scaling up	
Counties where already promoted if any	Kilifi, Makueni, Machakos, Baringo, Kitui, Coastal region
Challenges in dissemination	• Limited knowledge by farmers on use of IPM management practices • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Recommendations for addressing the challenges	• Establish mango 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
Lessons learned	• Adoption of good agricultural practices by farmersis key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the fruit fly management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES <2,000 per acre
Estimated returns	Over KES >30,000 per acre
Gender issues and concerns in development and dissemination	Acquisition, placement of traps and monitoring of the trapping of the pest can be applied by all genders.
Gender issues and concerns in adoption and scaling up	Create employment for the Youth- trap dissemination to agro dealers and service provision in management of the traps.
Gender related opportunities	Most VMG persons will be able to participate in management practice.
VMG issues and concerns in development and dissemination	Can create employment for VMG across the all segments of the value chain.
VMG related opportunities	Acquisition, placement of traps and monitoring of the trapping of the pest can be applied by all genders.
E: Case studies/profiles of success stories	
Success stories	Makueni and Elgeyo Marakwet Counties
Application guidelines for users	CABI-Plantwise Knowledge Bank
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requiresvalidation; 3=Requires further research	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Pole F., Thuranira D. and Otipa M.,
Partner organizations and contacts	CABI, ICIPE, KEPHIS, County Governments

2.6.3 Biological Control of Mango mealybug (*Rastrococcus iceryoides using Neem)*

2.6.3 Technology name	Biological Control of Mango mealybug (*Rastrococcus iceryoides using Neem)*
Category (i.e. technology, innovation or management practice)	Management practice  A colony of mealybugs on mango leaf (infonet.biovision)

A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity and poor quality of fruits due to invasive mealybug attack on mango trees. The damage by the mealybugs can lead to 40-80% yield reduction and infestated fruits are not acceptable in the export market.
What is it? (TIMP description)	• It is important to manage the mealybug during their development and reproduction stages to prevent stress on mango fruit trees. • Uses of neem-based biological products prevent pollution of the environment and possible poisoning of consumers.
Justification	• Invasive mealybug pests have increased in more orchards across the country preventing potential yield of mango fruits. • Various systemic insecticide molecules have been used interchangeably and incorporation of neem-based biological insecticides would increase efficacy of control and safe yield losses as well as increase sustainability of reduction of pollution of environment.
Region promoted	
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO and KEPHIS to continue undertaking research in insect management • PCPB to promote registration of biological control products for management of the insect pests and regulate the use of these bio pesticides • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness on bio pesticides. • Financial institutions to provide credit facilities • Private pesticide companies to promote and sell registered bio pesticides
Partners/stakeholders for scaling up and their roles	NGOs, extension, private service providers
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni

Counties where TIMP will be up-scaled / Validated	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers and extension agents on the use of bio pesticides • Unavailability of biopesticides in most agrochemical shops • Biopesticides take long to work and farmers like quick solutions to insectpest infestations • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Recommendations for addressing the challenges	• Train farmers and extension agents on use of biopesticides • Avail biopesticides in agrochemical shops near the farmers • Establish mango innovation platforms • Create awareness through campaign rallies • Promote use of bio pesticides in management of insecticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned	• Effective adoption of biopesticides byfarmers will be determined by their knowledge and availability of these products to farmers • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform •
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB to ensure bio pesticides sold to farmers are genuine and of high quality • Framer's willingness to adopt the mealy bugmanagement practices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <1,500 per acre where most farmers can afford.
Estimated returns	Over KES >25,000 per acre of gross margin returns expected.
Gender issues and concerns in development, dissemination. adoption and scaling up	• Improved grafted varieties areshort,making them easier to manage(spraying, pruning, harvesting)by all gender • The application procedure of the biological insecticides is gender friendly
Gender related opportunities	• Most persons will be able to participate in management practice
VMG issues and concerns in development and dissemination	• Improved grafted varieties areshort, making them easier to manage(spraying, pruning, harvesting)by all gender • The application procedure of the biological insecticides is gender friendly
VMG related opportunities	Can create employment for VMG across the segments of the value chain
E: Case studies/profiles of success stories	
Success stories	Makueni and Machakos County
Application guidelines for users	• CABI-Plantwise Knowledge Bank • Biovision

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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Pole F., Otipa M.
Partner organizations and contacts	CABI, ICIPE, KEPHIS, County Governments

2.6.4 Intergrated Management of Mango thrips(*Selenothrips* spp, *Scirtothrips* spp)

2.6.4 Technology name	**Intergrated Management of Mango thrips(*Selenothrips* spp, *Scirtothrips* spp)**
Category (i.e. technology, innovation or management practice)	Management practice  A thrips on mango leaf tissue (M.Kasina)
A: Description of the technology, innovation or management practice	
Problem addressed	Thrip infestation causes up to 30% yield loss on mango. The quality of mango is affected by thrip infestation.
What is it? (TIMP description)	Integrated management of thrips consists of several approaches applied in an integrated manner to break the insect cycle. These include: • Establishing wind breakers around the farm to prevent thrips blown by wind to the orchard • Maintain a conservation area around the farm to protect natural enemies such as green lacewings, pirate bugs, mites and parasitic wasp • Avoid planting alternate host crops such as cowpeaunder the mango trees • Prune mango trees to allow light penetration into the canopy • Remove old and plant debris and destroy byburning as they harbor thrips pupae

	• Spray the underside of the leaves with a solution of Beauveria bassiana such as Beuvitech early, before large thrips populations build up • Spray the underside of the leaves with a solution of neem-based products (Azadirachtin 0.3%) like Neemark, Achook, Nimbecidine • Hang yellow sticky traps 15cm above the foliage for trapping the thrips. 8 traps per acre • Use aluminum reflective mulch to keep away the thrips • Spray using Alpha-cypermethrin products like Alfatox 100EC,Tata Alpha 10EC or Spray Acetamiprid like Aceta 20SP. Acetak Top 70 WG
Justification	Upto 30% yield loss is experienced in the mango production systems. Management of thrips reduces plant stress during dry spells and prevents reduction of photosynthetic rate on fruit trees. Yield potential of the mango tree is restored after controllingdamage by thrips.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO to continue undertaking research in insect management • PCPB to upscale the registration and regulation of insecticides and biopesticides for management of the thrips in mango • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilities • Private pesticide companies to promote and sell registered pesticides
Partners/stakeholders for scaling up and their roles	• Farmers to produce • Exporters to create market pull • Extension service providers to disseminate crop information • Researchers and academia to conduct research
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni

Counties where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management practices • Few farmer groups • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Recommendations for addressing the challenges	• Establish mango 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
Lessons learned	• 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 upscaling	• Regulatory bodies e.g. PCPB to ensure pesticides 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	Cost for labour and inputs is KES <2,500 per acre
Estimated returns	Over KES >20,000 per acre of gross margin returns
Gender issues and concerns in development and dissemination	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to productive resources such as land, quality seed and credit • Women and youth have limited access to education, training and extension services than men • Improved grafted varieties are short making them easier to manage (spraying, pruning, harvesting) by all gender. • The application procedure of the biological insecticides is gender friendly.
Gender related opportunities	Create employment for the youth; in management dissemination to agro dealers and service provision in management of the thrips populations in the orchards.
VMG issues and concerns in development, dissemination VMG issues and concerns in adoption and scaling up	• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • 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 • Most VMG persons will be able to participate in management practice. • VMGs can easily adopt the management practices
VMG related opportunities	• Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	Makueni, County
Application guidelines for users	http://ipm.ucanr.edu/PMG/PESTNOTES/pn7429.html CABI - Plantwise Knowledge Bank
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requiresvalidation; 3=Requires further research	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-Kandara; P.O. Box 220-01000. Kandara Email: director.hri@kalro.org
Lead organization and scientists	KALRO Finyange Pole, DavidThuranira and Miriam Otipa
Partner organizations and contacts	CABI, ICIPE, KEPHIS, FPEAK, HCD, County Governments

2.6.5 Management of Mango hoppers

2.6.5 Technology name	**Management of Mango hoppers**
Category (i.e. technology, innovation or management practice)	Management practice  Leaf hoppers sucking on mango leaf (wikimedia commons)
A: Description of the technology, innovation or management practice	
Problem addressed	Up to 20% of mango yield is lost during flower setting due to infestation by plant hoppers.

What is it? (TIMP description)	Integrated management of plant hoppers is the applicationof several approaches applied in an integrated manner to break the insect cycle. It amay involve application of the following options: • Remove all infested fruits and debris from the field and destroy by burning or burying 50cm deep • Spray with Bacillus thuringiensis at 5-20 grams per 20 litres of water • Spinosad-based insecticides are most effective and safe since they are highly biodegradable
Justification	Invasive hoppers species have increased in more orchards across the country preventing potential yield of mango fruit in most areas. Application of Spinosad-based products break the insect life cycle and reduce the insect numbers, thereby securing higher yields of mango fruits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO to continue undertaking research in insect management • PCPB to promote registration of insecticides for management of the insect and regulate their use • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
Partners/stakeholders for scaling up and their roles	• Farmers to produce • Exporters to create market pull • Extension service providers to disseminate crop information • Researchers and academia to conduct research
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni
Counties where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega,

	Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers on use of soft products • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestionsfor addressing the challenges	• Establish mango innovation platforms • Dissemination use of sot products in themanagement of mango hoppers • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling if any	• Adoption of good agricultural practices by the producers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB 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	Cost for labour and inputs KES <2,000 per acre where most farmers can afford.
Estimated returns	Over KES >25,000 per acre of gross margin returns expected.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase inputssuch as insecticides • Women and youth have limited access to education, training and extension services than men • Acquisition, application and monitoring of the pest movement of the pest can be applied by all genders. • The application procedure of the pesticides is gender friendly
Gender related opportunities	Create employment for the youth-, who can access products from agro dealers and do service provision in management of the plant hoppers.
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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

VMG related opportunities	Can create employment for VMG across the all segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	Makueni, County
Application guidelines for users	CABI – Plantwise Knowledge Bank
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requiresvalidation; 3=Requires further research	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO; Pole F., Thuranira D. and Otipa M.
Partner organizations and contacts	CABI, ICIPE, KEPHIS, FPEK, HCD, County Governments

2.6.6 Integrated Management of Aphids on Mango

2.6.6 Technology name	**Integrated Management of Aphids on Mango**
Category (i.e. technology, innovation or management practice)	Management practice  Aphids feeding on leaf and fruit of mango plant (Infonet.biovision.com)
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids cause up to 30% yield loss of mango and reduce the marketability of mango fruits
What is it? (TIMP description)	Intergrated management of mango aphids is the selection of effective environmentally safe options. Example of such are: • Intercrop mango with repellant crops such as onions and garlic • Grow mango seedlings under insect protected environment such as greenhouse or under agronets • Weed the field to get rid of alternate host for aphids • Maintain a hedge around the mango field to conserve natural enemies and beneficial insects

	• Remove severely affected plants and destroy by burning • Use overhead irrigation to wash off aphids from the mango canopy • Use blue sticky traps at the rate of 8 traps per acre • Spray with neem oil 150ml/20 lts water and 100ml liquid soap/ water • Spray with Beauveria bassiana-based products such as Beauvitech WP • Spray Acetamiprid-based products like Aceta 20SP. Acetak Top 70 WG or lambda cyhalothrin products such as Pentagon or Deltamethrin-based products such as Atom, Decis
Justification	Mango aphid species have increased in orchards across the country preventing potential yield of mango fruit in most areas.The use of different insecticide molecules, both of biological and soft-chemical naturehasreduced resurgence of aphid populations in most orchards. IPM ensures aphid populations are kept below economic injury levels.  Black ants visiting mango fruit infested by aphids (link.springer.com)
Region promoted	Meru, Embu, Makueni, Machakos
Counties where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, exporters, extension service providers, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models

	• Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• KALRO to continue undertaking research in insectmanagement • PCPB to promote registration and regulation of pesticides in the management of insects • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilities • Private pesticide companies to promote and sell registered pesticides
Partners/stakeholders for scaling up and their roles	• Farmers to produce • Exporters to create market pull • Extension service providers to disseminate crop information • Researchers and academia to conduct research
C: Current situation and future scaling up	
Counties where already promoted if any	Practice adopted in some parts of Makueni county
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management practices • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish mango 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
Lessons learned if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • Chances of successful scaling of these technologies is higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB to ensure pesticides 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	Cost for labour and inputs KES <1,000 per acre where most farmers can afford.
Estimated returns	Over KES >20,000 per acre of gross margin returns expected.

Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase inputssuch as insecticides • Women and youth have limited access to education, training and extension services than men • Acquisition, application and monitoring of the pest movement of the pest can be applied by all genders. • The application procedure of the pesticides is gender friendly
Gender related opportunities	Create employment for the youth-, who can access products from agro dealers and do service provision in management of the plant aphids.
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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
VMG related opportunities	• Can create employment for VMG across the segments of the value chain. • Most VMG persons will be able to participate in management practice. • VMGs can easily adopt the management practices
E: Case studies/profiles of success stories	
Success stories	Makueni County
Application guidelines for users	Infonet.biovision.com CABI – Plantwise Knowledge Bank
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requiresvalidation; 3=Requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Pole F., Thuranira D. and Otipa M.
Partner organizations and contacts	CABI, ICIPE, KEPHIS, FPEAK, HCD, County Governments

2.6.7 Integrated management of mango anthracnose (*Collectotrichum gloesporioides*) and stem-end rot diseases (*Lasiodiplodia theobromae*)

2.6.7 TIMP Name	**Integrated management of mango anthracnose (*Collectotrichum gloesporioides*) and stem-end rot diseases (*Lasiodiplodia theobromae*)**
Category (i.e. technology, innovation or management practice)	Management practice  Anthracnose disease (Thuranira, D.M.)  Stem-end rot disease (Thuranira, D.M.)
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest fruit loss due to anthracnose and stem end-rot diseases
What is it? (TIMP description)	Integrated management of anthracnose and stem-end-rot encompasses the use of various approaches in management of the diseases and are applied during pre-harvest and pos-tharvest stages. These include: cultural management, deployment of tolerant varieties and chemical control. **Pre-harvest management practices:** **Cultural practices**: • Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs by burning or burying • Ensure that regular pruning is undertaken to remove diseased twigs and improve air circulation • Ensure that the orchard is weeded to remove weeds **Grow tolerant varieties**: • Grow varieties that are less susceptible to the disease such as Tommy Atkins **Chemical management**: • Apply fungicides from flower-bud formation stage until when fruits are fully developed. The most susceptible stage is bud-formation, flowering period and early fruit development • Use the following fungicides: Copper-based fungicides e.g. Cuprocaffaro WP, Trifloxystrobin + Tebuconazole-based fungicides e.g Nativo 300 SC or Carbendazim-based fungicides e.g. Rodazim SC

	Postharvest management **Hot water treatment** • Dip the fruits in warm water at 53^{o}C for 5-10 min. Ensure that the heat-treated fruits are handled carefully since they are proneto physical injury.
Justification	Anthracnose and stem-end rot (SER) are the major postharvest diseases causing up to 40% postharvest losses and reduce the mango shelf life in all growing regions in Kenya. Postharvest 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 and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Carry out applied and adaptive research to validate and release improved mango varieties • Create a platform for interaction of mango 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
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Embu, Makueni, Kwale, Kilifi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• Limited knowledge by farmers on integrated pest management practices • Few farmer groups • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish mango 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
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	• Regulatory bodies e.g. PCPB to ensure fungicides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 1,000 /acre for labour and cost of fungicides
Estimated returns	• Gross margin KES 109.044 per acre per season in 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land for women is limited • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase in putsdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Some integrated pest management practices e.g. application of fungicides are not conducive for the elderly
Gender related opportunities	• Youth can provide labour for practices such as fungicide application • Potential to create employment along the value chain e.g. agro chemical dealers, spray application services
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the pest integrated management practices such as pruning, spraying is difficult to undertake for VMG • Low access to credit facilities • The 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 • 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
VMG related opportunities	Can create employment for VMG across the all segments of the value chain.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Embu and Makueni have adopted these integrated management practice.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). Mango Propagation 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thuranira D.M., Mbaka J.N, Amata R., Otipa, M.and Finyange P.
Partner organizations	ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

2.6.8 Integrated management of Powdery Mildew (*Oidium mangiferae*)

2.6.8 TIMP Name	**Integrated management of Powdery Mildew (*Oidium mangiferae*)**
Category (i.e. technology, innovation or management practice)	Management practice  Photo by: Pole Finyange.
A: Description of the technology, innovation or management practice	
Problem to be addressed	40-100% yield losses occasioned by powdery mildew infection
What is it? (TIMP description)	Integrated management of powdery mildew consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control. **Cultural practices**: • Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs by burning or burying. • Ensure that regular pruning is undertaken to remove diseased twigs and improve air circulation • Ensure that the orchard is weeded to remove weeds **Chemical management**: • Apply fungicides during new leaves flush, bud formation or at flowering. New flushes of leaves are the most susceptible stages. • Use fungicides such as sulphur-based fungicides e.g.Thiovet jet WP, Trifloxystrobin + Tebuconazole-based fungicides e.g. Nativo 300 SC and Carbendazim-based fungicides e.g. Rodazim SC.
Justification	Powdery mildew is a major challenge in mango production in all production areas. The disease attacks leaves, flowers and twigs but is most destructive on the flowers causing drying and abortion of flowers. This could lead to total abscission of the bloom and 100% yield losses if the disease is not controlled.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, exporters, processors, extension service providers, researchers, academia and agripreneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Undertake applied and adaptive research to validate and release improved mango varieties • Create a platform for interaction of mango value chain stakeholders • Farmers adopt appropriate agronomic practices • Have well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continue undertaking research in disease management • KEPHIS to ensure the quality of seedlings is maintained • PCPB to promote registration of fungicides for management of the disease and regulate the use of pesticides • Farmers/farmer groups to adopt these technologies • County governments, central governments develop enabling policies and create awareness. • Financial institutions to provide credit facilitators • Private pesticide companies to promote and sell registered pesticides
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Embu, Makueni, Kwale, Kilifi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of extension staff • Limited of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Disseminate and promote integrated pest management practices and safe use of pesticides • Establish spray teams/champions • Support extension services
Lessons learned in up scaling if any	• Successful scaling up is possible if diverse value chain stakeholders collaborate in an innovation platform • 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. PCPB to ensure fungicides sold to farmers are genuine and of high quality. • Farmers' 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1,000/acre for labour and fungicide in 8th year
Estimated returns	Gross margin KES 109,044 per acre per season in 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land for women is limited • Some integrated pest management practices e.g. application of fungicides are difficult for the elderly to undertake. • Access and control of land for women is limited • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase in putsdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	• Youth can provide labour for practices such as fungicide application • Potential to create employment along the value chain e.g. agro chemical dealers, spray application services
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the pest integrated management practices such as pruning, spraying is difficult to undertake for VMG • Low access to credit facilities • Thecost 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 • 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
VMG related opportunities	Can create employment for VMG across the all segments of the value chain.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Embu and Makueni have adopted the management practice.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). Mango Propagation.

	2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.
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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thuranira D.M., Mbaka J.N, Amata R., Otipa, M.and Finyange P
Partner organizations	ICRAF, CABI, KEPHIS, Olivado

2.6.9 Mango scab (*Elsinoe mangiferae*

2.6.9 TIMP Name	**Mango scab (*Elsinoe mangiferae*)**
Category (i.e. technology, innovation or management practice)	Management practice  Scab disease in mango Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	Up to 90% yield losses due to infection by scab disease
What is it? (TIMP description)	Integrated scab disease management comprises of the use of cultural management practices, deployment of tolerant varieties and chemical control in the management of scab disease in mango **Cultural practices**: • Practise good field sanitation and hygiene practices by collecting and disposing infected fruits, leaves, and twigs. • Prune to remove diseased twigs and also improve on air circulation

	• Regularly weed the orchard is weeded and other agronomic practices carried out **Grow tolerant varieties**: • Grow varieties that are less susceptible to the disease such as Tommy Atkins **Chemical management**: • Apply fungicides from flower-bud formation stage until when fruits are half-grown. Fungicides that are effective areCopper-based fungicides e.g. Demildex WP, Trifloxystrobin + Tebuconazole-based fungicides e.g Nativo 300 SC and Carbendazim-based fungicides e.g. Rodazim SC
Justification	Mango scab disease may cause up to 90% yield losses if not well managed. The scarred tissues cause physical damage on the fruit making it unappealing for the market. In addition, the scared tissue may become entry point of other pathogens leading to fruit rots. This causes 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 and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Carry out Applied and adaptive research to validate and release improved mango varieties • Create a platform for interaction of mango 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

C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Embu, Makueni, Kwale, Kilifi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Few farmer group organizations • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish mango innovation platforms • Hold mass campaigns to create awareness on integrated pest management practices and safe use of pesticides
Lessons learned in up scaling if any	• Establish mango 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 up scaling	• Regulatory bodies e.g. PCPB 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1000/acre for labour and fungicides in 8th year
Estimated returns	Gross margin KES 109,044per acre per season in 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land for women is limited • Some integrated pest management practices e.g. application of fungicides are not conducive for the elderly • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasein putsdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	• Youth can provide labour for practices such as fungicide application • Potential to create employment along the value chain e.g. agro chemical dealers, spray application services
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the pest integrated management practices such as pruning, spraying is difficult to undertake for VMG • Low access to credit facilities

	• Thecost 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 • 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
VMG related opportunities	Can create employment for VMG across the all segments of the value chain.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Embu and Makueni have adopted the management practice.
Application guidelines for users	**Reference:** 1. Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). Mango Propagation 2. Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre
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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thuranira D.M., Mbaka J.N, Amata R., Otipa, M., and Finyange
Partner organizations	ICRAF, CABI, KEPHI, FPEAK

2.6.10 Integrated management of Sooty Mold

2.6.10 TIMP Name	Integrated management of Sooty Mold
Category (i.e. technology, innovation or management practice)	Management practice  Sooty mold and mango scales Photo by: Lusike Wasilwa
A: Description of the technology, innovation or management practice	
Problem to be addressed	30-50% yield losses occasioned bysooty mold infection on mango
What is it? (TIMP description)	Integrated sooty mold management consists of various approaches that help to break the disease cycle. They cultural management and chemical control. Sooty mold is associated with insect infestations that excreta sugary excreta which provides sugars for fungal growth on the plant. Disease is effectively managed by controlling insect infestations **Cultural practices**: • Practice good field hygiene practices by collecting and disposing infected fruits, leaves, and twigs. • Prune to remove diseased twigs and improve on air circulation • Ensure that the orchard is weeded regularly and other agronomic practices carried are out **Chemical management**: • Apply insecticides to manage insects. • Apply a fungicide such as Captan, Chlorothalonil (Daconil), Copper, Iprodione, mancozeb at 5–10% bloom and at full bloom. • Get other control products from the PCPB list of registered pest control products (www.pcpb.go.ke), and use them according to the manufacturer's instructions
Justification	The soot and the insect excreta make the fruit unappealing and unmarketable thus causing reduced farmer returns
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers, exporters, researchers, academiaand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings

	• Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Carry out applied and adaptive research to validate and release improved mango varieties • Create a platform for interaction of mango 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
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Embu, Makueni, Kwale, Kilifi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of Extension agents • Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish mango innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides in mango production • Dissemination of agronomic practices
Lessons learned in up scaling if any	• Establish mango 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. PCPB 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1000/acre in 8th year
Estimated returns	Gross margin KES 109,044 per acre per season in 8th year
Gender issues and concerns in development,dissemination, adoption and scaling up	• Access and control of land for women is limited • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase in puts due to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Some integrated pest management practices e.g. application of fungicides are not conducive for the elderly
Gender related opportunities	• Youth can provide labour for practices such as fungicide application • Potential to create employment along the value chain e.g. agro chemical dealers, spray application services
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG issues and concerns in development, dissemination, adoption and scaling up • Some of the pest integrated management practices such as pruning, spraying is difficult to undertake for VMG • Low access to credit facilities • Thecost 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 • 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
VMG related opportunities	Can create employment for VMG across the all segments of the value chain.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Embu and Makueni have adopted the most aspects of the integrated management of this disease.
Application guidelines for users	**Reference:** Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. andJohn N. (2019). Mango Propagation Griesbach, Jurgen. 2003. *Mango Growing in Kenya*. Edited by Anne Nyamu Marie and Tony Simons. Nairobi: World Agroforestry Centre.

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 – Horticulture Research Institute, Kandara P.O. Box 220-01000. **Thika** Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thuranira D.M., Mbaka J.N, Amata R., Otipa M.and Finyange P
Partner organizations	ICRAF, CABI

2.6.11 Management of Pigweed (*Amaranthus hybridus*)

2.6.11 TIMP Name	**Management of Pigweed (*Amaranthus hybridus*)**
Category (i.e. technology, innovation or management practice)	Management practice  Pigweed, a competitor for nutrients (Source: H. Mwangi)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations in mango orchards.
What is it? (TIMP description)	Management of mango pigweed to prevent nutrient and moisture competition on the fruit trees during development and reproduction stage. Hand machines could be used in small acreage and herbicides in large areas.  Hand-machine for weeding under trees (alibaba.com)

	It is important to implementtimely weed control measures in order stops all competitionforvarious nutrients, water and space.
Justification	Pigweed prevents potential yield of the fruit due to competition with the crop. To get good yields, control of the weed must be carried out early enough to prevent competition for resources. In some cases, yield loss as high as 50% has been reported on young mangoes due to competition for moisture and space with pigweed. Use of herbicides is recommended where the acreage is big.  Weeds in a mango orchard (Abouziena *etal,* 2016)
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Taking timely weed management measures. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up and their roles	NGOs, extension service providers, agro-input stockists, farmers
C: Current situation and future scaling up	
Counties wherea already promoted, if any	Machakos
CountieswhereTIMPwillbe up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit trees. • Little or no use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Choose best option; hand machine or herbicide.
Lessons learned	Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important so to prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <2,000 per acre where most farmers can afford. Consider KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >35,000 per acre of gross margin returns expected.
Gender issues and concerns in development, dissemination, adoption and scaling up	The application procedure of the herbicide is gender friendly. Use of hand machines should be tested to ensure women and youth are taken care of.
Gender related opportunities	Creates employment for the youth who can use modern hand weeding equipment, and make money as service providers.
VMG issues and concerns in development, dissemination,adoption and scaling up	Most VMG persons will be able to participate in management practices of weeds if machine weeding is disseminated.
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness(1=Ready for upscaling: 2=Requires validation; 3=Requires further research)	1=Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO

	Hottensiah Mwangi, Violet Momanyi, Finyange Pole, DavidThuranira
Partner organizations and contacts	CABI, ICIPE, County Governments

2.6.12 Management of Wandering Jew weed (*Commelina benghalensis*)

2.6.12 TIMP Name	**Management of Wandering Jew weed (*Commelina benghalensis*)**
Category (i.e. technology, innovation or management practice)	Management practice  Wandering Jew, a common weed in most areas (Source: V. Momanyi)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of wandering jew in mango orchards to prevent nutrient and moisture loss is a prerequisite for normal development and reproduction on mango crop. Hand machines could be used in smaller acreage and herbicides in larger areas. Various options such as weeding machines and herbicides use are available.
	 A hand-weeding machine with exchangeable weeders (alibaba.com).

	Knowing the critical time to weed the orchard is important as this will remove unnecssary competition to the mango crop and prevent spread of pests haboured in the weeds. Use of herbicides will economically wipe out the weeds that are re-growing too fast, rather than weeding with a machine.
Justification	The wandering jew weed in mango orchards prevents the realization of potential yield of mango fruit in most areas due to competition with the crop for nutrients. A decision has to be reached to make a choice of method for weed control. Use of herbicide spray where the acreage is huge while a hand engine-driven machine is sufficient for 5-10 acres.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, Research institutionsand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures taken. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Herbicides are used in all counties albeit to varying extents
CountieswhereTIMPwillbe up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for the presence of the weed in orchards before herbicide application for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide on what method to use under the prevailing circumstances; either hand machine or herbicide.
Lessons learned	Timely application of the control method is important for effective management of the weeds.

Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important to prevent pollution of agro ecosystems. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <2,000 per acre where most farmers can afford. Consider KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >35,000 per acre of gross margin returns expected.
Gender issues and concerns in development and dissemination Gender issues and concerns in adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weeder due to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of.
Gender related opportunities	• Create employment for the youth who can use modern hand weeding equipment and enjoy making money as service providers. • The machine reduces the work burden of women.
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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
VMG related opportunities	• Can create employment for VMG across the segments of the value chain. • VMGs can easily adopt the management practices especially where hand machine-weeding is possible
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further research)	1=Ready for upscaling
Lead organization and scientists	KALRO Mwangi H.,, Momanyi V., Pole F., Thuranira D.

Partner organizations and contacts	NGOs, extensionservice providers, County Governments, farmers

2.6.13 Management of Gallant Soldier weed (*Galinsoga parviflora*)

2.6.13 TIMP Name	**Management of Gallant Soldier weed (*Galinsoga parviflora*)**
Category (i.e. technology, innovation or management practice)	Management practice  Gallant soldier weed (Source: V. Momanyi)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of gallant soldier to prevent nutrient and moisture competition on the fruit trees during development and reproduction stage. Hand machines could be used in smaller acreage and herbicides in large areas.
	 The weeders for the hand-engine driven machine (alibaba.com)
Justification	The gallant soldier weed in most mango orchards prevents potential yield of mango fruit in most areas due to competition with the crop.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP)

	• Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures need to be taken. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Counties where promoted if any	Machakos
Counties where TIMP will be be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango farming. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide better option; hand machine or herbicide.
Lessons learned	• Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important so to prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <2,000 per acre where most farmers can afford. Consider KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >35,000 per acre of gross margin returns expected.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weeder due to limited access to creditfacilities

	• Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of.
Gender related opportunities	Create employment for the youth who can use modern hand weeding equipment and make money as service providers. The machine reduce the work burden of women
VMG issues and concerns in development, dissemination, adoption and scaling-up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are trained on how to use the weeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated.
VMG related opportunities	• Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further research)	1=Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.14 Management of Datura Weed (*Datura stramonium*)

2.6.14 TIMP Name	**Management of Datura Weed (*Datura stramonium*)**
Category (i.e. technology, innovation or management practice)	Management practice  Datura weed (Source: V. Momanyi).
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of Datura weed is important to prevent nutrient and moisture competition on the fruit trees during development and reproduction stage. Hand machines could be used in smaller acreage and herbicides in large areas. Weeding around the plant base ensures that moisture atthe plant base is assimilated by the mango tree.  Operating a hand-driven engine machine (Alibaba.com) Where intercropping is practised with other annual crops, a hand-driven machine can be used to remove weeds like Datura from the base of the mango tree.
Justification	Datura weed prevents potential yield of mango fruit in mango orchards due to competition with the crop for sunlight or harboring

	various pests. Hence need to make sure no yield reduction due to competition with other resource sharers like Datura. Up to 40% yield loss can occur especially during dry spell period. Thus farmers affordable control options are adopted. Use of herbicides could be the only option to control the weeds in other areas where production acreage is big.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, Research institutions and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Taking timely weed management measures. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up and their roles	NGOs, extension service providers, stockists, farmers
C: Current situation and future scaling up	
Counties where promoted if any	Machakos
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide better option; hand machine or use of herbicide.
Lessons learned	• Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions	• Environmental health considerations are important in preventing pollution of agro ecosystem.

necessary for development and upscaling	• Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and herbicide inputs KES <1,500 per acre where most farmers can afford. In addition, KES 15,000 for engine-hand machine bought once as capital investment.
Estimated returns	Over KES >25,000 per acre of gross margin returns expected once weed control is achieved
Gender issues and concerns in development, dissemination,adoption and scaling-up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weeder due to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of.
Gender related opportunities	Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
VMG issues and concerns in adoption and scaling-up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use theweeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated.
VMG related opportunities	• Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling:	1=Ready for upscaling

2=Requiresvalidation; 3=Requires further research	
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.15 Management of three-star thorn thistle weed (*Oxygonum sinuatum*

2.6.15 TIMP Name	**Management of three-star thorn thistle weed (*Oxygonum sinuatum*)**
Category (i.e. technology, innovation or management practice)	Management practice  The three-starthorn thistle weed (Source: V. Momanyi)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of the three-star thorn thistle to prevent nutrient and moisture competition with seedlings during development and reproduction stage. Hand machines could be used in smaller acreage and herbicides in larger areas. Making plastic covers along the tree rows serves as a permanent method of preventing weed establishment. This prevents any weed growth and promotes moisture to remain underground of the mango plants.

	 White plastic cover (Schoolarsresearchlibrary.com)
Justification	The Three-Thorn thistle weed in mango orchards takes up moisture in the plots leading to yield loss of the crop in most areas due to competition with the crop. As the resources are competed for by fast growing three-star thornthistle it becomes important to control before full colonization of the plots. Yield loss can be prevented by planning early on how to prevent competition from weeds.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutionsand agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures taken. • Changing herbicide molecules in good time to prevent resistance by the weeds.
Partners/stakeholders for scaling up	NGOs, extension service providers, stockists, farmers
C: Current situation and future scaling up	
Counties where TIMP will be up-scaled	None
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides.

	• Little choice of selective herbicides for the crop. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide best option; hand machine or herbicide.
Lessons learned	Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important so that pollution of agro ecosystem is prevented. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <1,800 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >20,000 per acre of gross margin returns expected once crop gains health status.
Gender issues and concerns in development, dissemination, adoption and scaling-up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weederdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of. • Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
Gender related opportunities	Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers. The weederwill reduce the work burden of women
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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

	• Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use theweeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness(1=Ready for upscaling; 2=Requiresvalidation; 3=Requires further research)	1=Ready for upscaling
G: Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.16 Management of Blackjack weed (*Bidens pilosa*)

2.6.16 TIMP Name	**Management of Blackjack weed (*Bidens pilosa*)**
Category (i.e. technology, innovation or management practice)	Management practice  Blackjack showing maturing spikes (facebook.com)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.

What is it? (TIMP description)	Management of blackjack weed to prevent nutrient and moisture competition with mango plants during development and reproduction stage. Hand machines could be used in smaller acreage and herbicides in large areas. Choice of control methods is dependent on acreage of production. Selective herbicides can be used to eliminate blackjack.  Hand spraying will lead to clean fields as the herbicides kill the weeds (en.wikipedia.com)
Justification	Blackjack in mango orchards takes up moisture in the plots leading to yield loss of mango fruit due to competition with the crop though no yield loss is expected if trees are mature. Where the weed has colonized the orchard, it becomes uncomfortable to pass through fields when its spikes have grown and matured.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures taken. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up and their roles	NGOs, extension service providers, stockists, farmers
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMP will be promoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide better option; hand machine or herbicide.
Lessons learned	• Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important to prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practice.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <1,800 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >20,000 per acre of gross margin returns expected once crop gains health status.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase farm machines such a at the weederdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of. • Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
Gender related opportunities	• Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers. • The weeder will reduce the work burden of women
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use the weeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	Mango farmers in Makueni, Machakos, Kitui Counties.
Application guidelines for users	Production manuals to include use of hand machines and selective herbicides for weed management.
F: Status of TIMP readiness(1=Ready for upscaling;2=Requiresvalidation; 3=Requires further research)	1=Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.11 Management of Goat weed (*Ageratum conyzoides*)

2.6.11 TIMP Name	**Management of Goat weed (*Ageratum conyzoides*)**
Category (i.e. technology, innovation or management practice)	Management practice
	 Goat weed (app.lucidcentral.org)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of goat weed to prevent nutrient and moisture competition of mango seedlings during development and reproduction stage. Hand machines could be used in smaller acreage and herbicides in large areas. Otherwise farmers will make choice of option for control depending on crop age and environmental factors like rainfall amount.
Justification	Goat weed in mango orchards would take up moisture in the plots causing yield loss of mango fruit in most areas due to competition with the crop.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Timely weed management measures taken. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMP will be up-scaled	Kilifi, Murang'a, Kitui, Embu, Kajiado, Kwale, Tana River, Makueni
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide better option; hand machine or herbicide.
Lessons learned	Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important to prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and inputs KES <1,500 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >22,000 per acre of gross margin returns expected once crop gains health status.
Gender issues and concerns in development, dissemination, adoption and scaling-up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weederdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of. • Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.

Gender related opportunities	• Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers. • The weeder will reduce the work burden of women
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use theweeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requiresvalidation; 3=Requires further research)	1=Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.18 Management of Couch grass weed

2.6.18 TIMP Name	Management of Couch grass weed
Category (i.e. technology, innovation or management practice)	Management practice  Couch grass full colonization (www.insectimages.org)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestations that cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of couch grass to prevent nutrient and moisture competition of mango seedlings during development and reproduction stage is important. Hand machines could be used in smaller acreage and herbicides in large areas.
Justification	Couch grass weed in mango orchards competes for moisture in the plots leading to yield loss of mango fruit in most areas. The grass takes up much of the moisture from the plant base of the mango trees. Efforts to manually suppress the weeds are complicated by torrentialrainfall in wetter areas. When it is hot and before it dries up, application of the herbicide becomes critical to control the weed grass.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/ essential factors for successful promotion	• Taking timely weed management measures. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide best option; hand machine or herbicide.
Lessons learned	• Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important to prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and herbicide inputs KES <3,000 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >30,000 per acre of gross margin returns expected once crop gains health status.
Gender issues and concerns in development, dissemination adoption and scaling-up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchase farm machines such a at the weeder due to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of. • Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
Gender related opportunities	Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers. The weeder will reduce the work burden of women
VMG issues and concerns in development,	• The technology is labour intense and may be difficult for the VMG to implement in the field.

dissemination,adoption and scaling-up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use theweeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness(1=Ready for upscaling; 2=Requiresvalidation; 3=Requires further research)	1 = Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	CABI, ICIPE, County Governments

2.6.19 Management of Sow thistle weed (*Sonchus oleraceae*)

2.6.19 TIMP Name	**Management of Sow thistle weed (*Sonchus oleraceae*)**
Category (i.e. technology, innovation or management practice)	Management practice
	 Sow thistle weed plant (diegobonetto.com)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestationsthat cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Integrated Weed Management (IWM) for sow thistle is an approach to managing weeds using multiple appropriate approaches including preventive, planting in a weed free prepared land, use of mulch (biodegradable or synthetic), cultural, rotation, intercropping and chemical control depending on the weed types and severity in the field. Weed management considerations can include use of herbicides, machines or hand weeding using a panga or jembe.
Justification	Although manual weeding can be effective for managing some weed species, it is time consuming and labour intensive. Judicious use of herbicides integrated with cultural methods gives a promising option for weed control in mango cropping systems. Application of herbicides such as glyphosate is done using a hooded sprayer, shielded sprayer or wick.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures should beapplied. • Changing herbicide molecules in time to prevent resistance by the weeds. Promote and train on integrated weed management (IWM). • Address environmental and safety concerns related to herbicide use • Promotion, demos and field days with farmer groups and stakeholders on effectiveness of the various weed management options using Farmer Field Business School (FFSB) approach. • Train users on appropriate and safe use of herbicides.
Partners/stakeholders for scaling up and their roles	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Counties already promoted if any	None
Counties where TIMP will be apromoted	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree. • Little use of hand machines.
Recommendations for addressing the challenges	• Scout for weed presence in orchards before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide best option; hand machine or herbicide.
Lessons learned	Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important prevent pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and herbicide inputs KES <2,000 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >25,000 per acre of gross margin returns expected once crop gains health status.

Gender issues and concerns in development, dissemination, adoption and scaling-up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to purchasefarm machines such a at the weederdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly • Hand machines use be tested to ensure women and youth are taken care of. • Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
Gender related opportunities	• Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers. • The weederwill reduce the work burden of women
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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 • Most VMG persons will be able to participate in management practice of weeds if they are properly trained on how to use theweeder machine • Most VMG persons will be able to participate in management practice of weeds if machine weeding is disseminated
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requiresvalidation; 3=Requires further research)	1=Ready for upscaling

G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.6.14 Management of Dodder weed (*Cuscuta japonica*)

2.6.14 TIMP Name	Management of Dodder weed (*Cuscuta japonica*)
Category (i.e. technology, innovation or management practice)	Management practice  Japonica Dodder species weed (koeeorg.wordpress.com)
A: Description of the technology, innovation or management practice	
Problem addressed	Weed infestationsthat cause competition for plant growth resources such as water, mineral nutrients and space.
What is it? (TIMP description)	Management of the dodder weed needs special considerations. Selective foliar herbicides could be most applicable since the plant attaches itself to various nutrient pathways of mango plant. Consider integration with cultural methods like field hygiene when transplanting the seedlings to the main field and also removal of the weed by hand.
Justification	Dodder weed colonizes orchard trees and feeds from the top canopy of the plants. After 6 months to one year, the plants start drying (dying), hence 100% loss with death of the mango trees. Selective herbicide application would suitably control the Dodder weed on the mangoes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, NGOs, research institutions, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS)

	• Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Timely weed management measures taken. • Changing herbicide molecules in time to prevent resistance by the weeds.
Partners/stakeholders for scaling up and their roles	NGOs, extension, stockists, farmers
C: Current situation and future scaling up	
Counties promoted if any	
Challenges in dissemination	• Lack of knowledge on how and when to apply selective herbicides. • Little choice of selective herbicides for mango fruit tree.
Recommendations for addressing the challenges	• Scout for weed presence on top of canopies before application of herbicide for economic advantage. • Apply herbicides before weeds colonize the orchards. • Decide best option; hand machine or herbicide.
Lessons learned	• Timely application of the control method is important for effective management of weeds.
Social, environmental, policy and market conditions necessary for development and upscaling	• Environmental health considerations are important in prevention of pollution of agro ecosystem. • Right policy for use of herbicides and social inclusion by gender will enable implementation of the practices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost for labour and herbicide inputs KES <3,000 per acre where most farmers can afford. Consider additional KES 15,000 for hand machines bought once as capital investment.
Estimated returns	Over KES >30,000 per acre of gross margin returns expected once crop gains health status.
Gender issues and concerns in development, dissemination,adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • The application procedure of the herbicide is gender friendly

	• Acquisition, application and monitoring of the weed increase can be of economic gain when management is applied at right time.
Gender related opportunities	Create employment for the youth-, who can use modern hand weeding equipment and enjoy making money as service providers.
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • 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
VMG related opportunities	Can create employment for VMG across the segments of the value chain.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP readiness	
(1=Ready for upscaling; 2=Requiresvalidation; 3=Requires further research)	1=Ready for upscaling
G. Contacts	
Contacts	Institute/Centre Directors, KALRO-Kabete, Katumani, Mtwapa, Kandara
Lead organization and scientists	KALRO Mwangi H., Momanyi V., Pole F. and Thuranira D.
Partner organizations and contacts	NGOs, extension service providers, County Governments, farmers

2.7 Mango Post-Harvest Management

2.7.1 Harvesting

2.7.1 TIMP Name	Harvesting
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Occurrence of postharvest losses due to incorrect harvesting stage, timing of harvest and inappropriate harvesting methods
What is it? (TIMP description)	This is a management practice involving proper identification of maturity indices, pre-harvest operations and harvesting procedure. **Maturity indices and correct time for harvesting** Mango fruit is harvested at 120-140 days from fruit set to harvest, depending on the variety. At this stage, shoulders of mango fruits get sunken and loosely attached to the stalks.The dark green fruits start turning pale green to yellowish at maturity. The flesh turns from white to yellow. **Harvesting** Harvesting of mango is mostly done manually.Manual harvesting is done by cutting the fruit with 3-4cm stalk with sharp secateurs or shears. Then the latex is drained by turning the fruit upside down. The mangoes are stacked in clean crates ready for transportation.
Justification	Unsuitable harvesting stage, improper harvesting time and inappropriate harvesting methods lead to losses of mango fruit. Harvesting before the maturity of the crop results in lower yields and poor quality fruits. Delay in harvesting results in fruit rotting and other losses such as shriveling.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processors, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Access to markets for quality mango fruits • Better pricing of quality fruits

	• Availability of extension officers to assist in up-scaling the management practice
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 mangoto disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Tharaka Nithi,
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge and appropriate harvesting technology • Negative attitude by farmers towards adoption of new agricultural TIMPs • Low uptake before the farmers see results
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of farmers on appropriate harvesting • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	It is essential to create awareness to farmers on cost implication of poor harvesting practices
Social, environmental, policy and market conditions necessary for development and up scaling	• Producersare willing to adopt mango harvesting management practices • Ensure that producers harvest fruits at the right time and use appropriate harvesting methods • Opportunities for increased returns due to appropriate harvesting techniques, proper harvesting time and harvest stages
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income and nutrition (due to appropriate harvesting techniques)
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Mango is mainly harvested by youth, hence these should be targeted • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting.
Gender related opportunities	• The TIMP increases farm income through reduction of harvest losses. Youth can capitalize on this aspect of mango production to reduce harvest losses
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some of the activities such as harvesting is difficultfor VMG • VGMs have low finances due to limited access tocredit facilities

	• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • 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 • Mechanical harvesting can be encouraged to all gender, including the VMGs.
VMG related opportunities	• Adoption of the TIMPs means reduced losses, hence more mango available for consumption and sale. This will enable VMGs to have enough mango to consume, hence get micro-nutrients (especially vitamins and 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	Mango harvesting leaflets and manuals
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps:

1. Up-scaling maturity indices of the various mango varieties
2. Quantification of the losses due to incorrect timing of the right maturity for harvesting different mango varieties

2.7.2 Fruit harvesting tool

2.7.2 TIMP name	Fruit harvesting tool
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Poor harvesting practices that lead to mechanical injuries and ultimately high postharvest losses in mango value chain
What is it? (TIMP description)	 Mango harvesting too (originally from Brazil)
Justification	High post-harvest losses occur due mechanical injuries on fruits caused by poor harvesting practices. Use of a fruit harvesting tool reduces mechanical injury on mango fruit thus minimizing losses
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango producers, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Fabrication of the equipment by local artisans • Cost/benefit analysis
Partners/stakeholders for scaling up and their roles	• Local artisan to fabricate the equipment • Extension officers to assist in demonstration • Research institutions for data to support research
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru, Machakos, Kilifi, Tana River

Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Availability of the tool if demand is created
Suggestions for addressing the challenges	Build capacity for local production of the tool – Jua Kali sector
Lessons learned in up scaling, if any	The harvesting tool need be fabricated with locally available materials
Social, environmental, policy and market conditions necessary for development and upscaling	The extra cost of production must be matched with better returns – better prices for the mango fruits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	None
Estimated returns	Not done – need to establish the benefit observing harvest maturity
Gender issues and concerns in development, dissemination, adoption and scaling-up	The technology mainly targets the youth who are mainly engaged in mango harvesting
Gender related opportunities	Create employment for the youth- engaged in harvesting
VMG issues and concerns in development,dissemination, adoption and scaling-up	• VMG may not easily adopt the technology since it is involving physically • Some of the activities such as harvesting is difficultfor VMG • VGMs have low finances due to limited access tocredit facilities • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • 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 • Mechanical harvesting can be encouraged to all gender, including the VMGs.
VMG related opportunities	• Create employment for the Youth- engaged in harvesting
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Reduced mechanical injuries in harvested fruits – reduced postharvest losses
Application guidelines for users	
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	KALRO, TECHNOSERVE, HCD, FPEAK

2.7.3 Sorting and grading of mango

2.7.3 TIMP Name	Sorting and grading of mango
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inferior quality and low prices from unsorted and ungraded mangoes
What is it? (TIMP description)	Sorting is done to remove damaged, diseased, insect damaged, rotten, bruised, and discolored and debris. Grading is done to categorizemango fruits according to size, weight, maturity, physical damage, and market demand.
Justification	Sorting helps to eliminate mangoes of poor quality and prevent cross contamination between spoilt and good fruits. Mangoes of superior quality fetch higher prices in the market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Better pricing for quality fruits • Access to superior markets
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 mangoto disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Tharaka Nithi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge and appropriate sorting and grading technology • Negative attitude by farmers towards adoption of new agricultural TIMPs • Low uptake before the farmers see results
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of farmers on appropriate sorting and grading • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	Create awareness to farmers on cost implication of not sorting and grading the fruits
Social, environmental, policy and market conditions necessary for development and up scaling	• Opportunities for increased returns due to appropriate sorting and grading techniques
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income and nutrition (due to appropriate sorting and grading techniques)
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Mango is cultivated by all gender, hence men, women and youthsshould be targeted • The TIMP is easily adoptable after training and many farmers can use the technology as it reduces postharvest losses
Gender related opportunities	The TIMP increases farm income through reduction of losses experienced due to lack of sorting and grading technologies. Women can capitalize on this aspect of mango production to reduce sorting and grading losses
VMG issues and concerns in development, dissemination, adoption and scaling up	Manual sorting and grading can be practised by energetic women and youth.
VMG related opportunities	Adoption of the TIMPs means reduced losses, hence more mango available for consumption and sale. This will enable VMGs to have enough mango to consume and sell. There will be increased employment for the youth
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Mango sorting and grading leaflets, factsheets and manuals

F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural Universities/Colleges, MoALF, NGOs, CBOs

Gaps:

1. Validation of mechanization sorting and grading of mango
2. Further research on sorting and grading cards technologies

2.7.4 Zero energy brick cooler

2.7.4 TIMP Name	**Zero energy brick cooler**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses (50%) caused by lack/limited cooling technologies for mango
What is it? (TIMP description)	The Zero Energy Brick Cooler consist of a double brick wall filled with sand in between, and a storage chamber. The sand is kept moist with water. The inside chamber is cooled through evaporation of the water in the sand.  Zero energy brick cooler
Justification	Appropriate cooling reduces postharvest losses, reduces nutrient losses and extends shelf-life

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, green grocers, processors, household consumers, , research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Use of locally available materials to construct the chamber • Formation of marketing groups that would construct the chamber communally
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the mangoes • Research scientists and agricultural extension workers to provide farmers with knowledge on ZECC
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Tharaka Nithi
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Lack of starter capital to construct the cooler
Suggestions for addressing the challenges	Avail appropriate financing
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the ZECC
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Low cost about KES 80,000
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development,dissemination, adoption and scaling-up	The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting.
Gender related opportunities	The TIMP increases farm income through reduction of harvest losses by pre cooling produce. Women can capitalize on this aspect of mango production to reduce harvest losses

VMG issues and concerns in development, dissemination, adoption and scaling up	
VMG related opportunities	• Adoption of the TIMPs means reduced losses, hence more mango available for consumption and sale. There will be more income for the farmers (VMGs). • Construction of the cooler can be an opportunity for youths in offering employment opportunities
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. have used the technology to reduce losses and extend shelf-life for mangoes and other fruits and vegetables, hence the marketing time for the products.
Application guidelines for users	Factsheets, brochures and manuals on Postharvest handling of mango from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural Universities/Colleges, MoALF, NGOs, CBOs

Gaps:

1. Validate the technology in different mango growing areas
2. Research on innovative investment options for farmers and groups.

2.7.5 CoolBot™

2.7.5 TIMP Name	**CoolBot™**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of appropriate cooling technologies for fruits
What is it? (TIMP description)	It is a low-cost postharvest temperature management technology that improves the shelf life of fruits and vegetables using less power. The Coolbot™ is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lower cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as

	4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.  Coolbot™
Justification	CoolBot provides inexpensive, effective cooling. Appropriate cooling reduces postharvest losses and extends shelf-life for consumption and marketing. Farmers who can store their produce longer can take advantage of better prices, as market prices can fluctuate dramatically over time
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processors, research service providers, extension service providers and agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Increase postharvest training and direct farmer outreach • Issuing out leaflets on postharvest management
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of mango • Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot™ Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling mangoes • Limited awareness of the technology by farmers • Inadequate funds to install the CoolbotTM
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders

	• Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	• Linking entrepreneurs to credit and market enhances adoption of CoolbotTM technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the CoolBot™
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	CoolBotTM (US$ 300) Air conditioner Insulated room Monthly electricity costs
Estimated returns	• Increased income. Farmers can store mangoes to sell in the off-season when prices are higher. • Improved cold storage facilities will stabilize fruit and vegetable prices, giving consumers access to nutritious fresh produce all year. • Farmers are better protected to erratic market prices.
Gender issues and concerns in development,dissemination, adoption and scaling-up	Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	Women and youth stand to benefit in installation of the Coolbot™
VMG issues and concerns in development, dissemination, adoption and scaling up	• Mangoes have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mangoes. • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough mangoes to consume, hence get macro- and micronutrients • The consumer will pay less for high quality mangoes • The grower will also not be forced to make distress sale and will get better return
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc. Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.

Application guidelines for users	CoolBot™ factsheets, brochures and manuals available from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps:

1. Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the CoolBot™.
2. Validating the CoolbotTM for mango storage under different AEZ
3. Gross margins of the Coolbot™
4. Validation of the technology using alternative of electricity (for example solar)

2.7.6 Wakati™ technology

2.7.6 TIMP Name	**Wakati™ technology**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of cooling technologies for mangoes
What is it? (TIMP description)	Wakati™ is a simple and innovative solution where altered environment in the chamber contributes to shelf life extension - Altered environment is due to: High relative humidity - Oxidation of ethylene from the storage environment (ozone oxidation) It is a 1m by 1m canvas tent with a solar powered fan at one corner. The fan is placed in cuplike reservoir. As it rotates, it picks up water into mist droplets, which are distributed in the tent by air currents. When a moisture concentration of 80% is achieved, the surface of the fruit or vegetables remain fresh because there is no loss of water. This low-cost solution helps produce last up to 10 times longer without any refrigeration
Justification	Appropriate cooling reduces postharvest losses. The technology increases the length of time fruits can be stored without refrigeration, gives farmers more time to sell. The climate control approach used by Wakati™ is affordable and clean technology.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh fruits (green grocers), research service providers, extension service providers and agripreneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	The optimal use of Wakati^{TM}.is outside, in a warm and dry climate. Apart from a small amount of water - around 1L of water a week - it does not require any extra resources. The product does not need a power grid, it works on solar energy.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the fruits • Scientists and agricultural extension workers- to provide farmers with knowhow on WakatiTMTechnology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up-scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling mangoes. • Limited awareness of the technology by farmers • Inadequate funds to install the WakatiTM
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up scaling	• To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the Wakati^{TM}
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000
Estimated returns	Not yet done

Gender issues and concerns in development ,dissemination, adoption and scaling up	• Mango production is for allgender, hence men, women and youths should be targeted • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting.
Gender related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mangoes. • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough mangoes to consume, hence get macro- and micronutrients • The consumer will pay less for high quality mangoes • The grower will also not be forced to make distress sale and will get better return.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Mangoes have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, etc.
Application guidelines for users	Factsheets, brochures and manuals on Postharvest handling of mangoes from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural Universities/Colleges, MoALF, NGOs, CBOs

2.7.7 Use of crates during packaging, storage, transportation and marketing of mangoes

2.7.7 TIMP name	Use of crates during packaging, storage, transportation and marketing of mangoes
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Poor packaging during postharvest handling lead to physicalinjuries and ultimately high postharvest losses in mango
What is it? (TIMP description)	 Nestable crate Plastic crates (ordinary bread crates) which can be used to package mango fruits during postharvest handling to minimize physical dermage. Nestable crates are space-saving version that should be promoted for transporters 
Justification	  Most traders/transporters do not package mango appropriately. They package them in sacks or load them into open tracks without any packaging. This leads to excessive mechanical injuries and ultimately high Post-harvest losses. This can be minimized by proper packaging during handling.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango producers, aggregators, traders, agri-preneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Participatory approach • Cost/benefit analysis • Policy directive that prohibits poor packaging and promotes the use of crates
Partners/stakeholders for scaling up and their roles	• Extension officers and NGOs to promote the technology • Research institutions for updates of the technology • Manufacturers of crates to provide the crates
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru, Kilifi,
Counties where TIMP will be upscaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Availability and cost of the plastic crates if demand is created • Slow adoption of the technology especially with traders and transporters
Suggestions for addressing the challenges	• Build capacity for traders on effect of using crates in reducing losses • Policy directive that prohibits the use of sacks or open lorries to transport perishable produce
Lessons learned in up scaling, if any	• Negative attitude from traders • Need forspace saving collapsible crates to reduce the cost transporting empty crates after delivering produce to the market
Social, environmental, policy and market conditions necessary	The extra cost of must be matched with better returns /better prices for the mango fruits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ordinary bread crate (KES 500 – 700) Nestable crate (KES 750
Estimated returns	Not done – need for cost benefit analysis study
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology mainly targets the youth engaged in mango trading • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting

Gender related opportunities	Create employment for the Youth- engaged in harvesting
VMG issues and concerns in development and dissemination	VMG may not easily adopt the technology since it is involving physically
VMG issues and concerns in adoption and scaling up	VMG may not easily adopt the technology since it is involving physically
VMG related opportunities	Increased job opportunities for the VMG
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Adopted by farmers in Yield wise project areas (Embu, Meru, and Taita Taveta). There is evidence of reduced postharvest losses
Application guidelines for users	• Flyer or poster showing how mangoes are packaged in the crates • Photo evidence of reduced injuries on harvested fruits
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO, Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	TECHNOSERVE, HCD, FPEAK

2.7.8 Use of Hexanal to extend mango shelf life

2.7.8 TIMP Name	**Use of Hexanal to extend mango shelf life**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Despite economical and nutritional importance of mango fruits, there is high postharvest loss due to rotting and short shelf life.
What is it? (TIMP description)	Hexanal, a naturally occurring plant derived compound is known to inhibit phospholipase-D and facilitates extension of shelf-life of fruits during storage. The fruits are sprayed with 2% hexanal formulation at 15 and 30 days before harvest and then post-harvest dip for two minutes. This reduces incidence of post-harvest diseases such anthracnose and stem end rot and also extend fruit shelf life up to 25 days compared to 14 days when they are not sprayed.

Justification	The hexanal formulation spray extends the shelf life of mango fruits and reduce rotting.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and traders/exporters of mango fruits, agri-preneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Increased postharvest handling trainings for the small scale farmers and traders
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained on use of hexanal sprays of the mangoes • Scientists and agricultural extension workers- to provide farmers with knowhow on use of hexanal sprays
C: Current situation and future scaling up	
Counties where already promoted if any	Meru on banana
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Lack of knowledge on the technology and the benefits Limited awareness of the technology by farmers and traders
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	No documentation accessed
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the hexanal spray technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not yet done
Gender issues and concerns in development ,dissemination, adoption and scaling up	Women may not have access to resources required for adoption of the enterprise.

Gender related opportunities	• Mango have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes. • Opportunity for the VMGs to have access to distance markets • Use of the technology can reduce postharvest losses and enable VMGs have enough mango to consume, hence get macro- and micronutrients • The consumer will pay less for high quality mango • The grower will also not be forced to make distress sale and will get better return.
VMG issues and concerns in development, dissemination, adoption and scaling up	Mango have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mango. • Use of the technology can reduce postharvest losses and enable VMGs have enough mango to consume, hence get macro- and micronutrients
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Not documented
Application guidelines for users	Lusike W., Pole F., Violet K., Kori N., Muo K., Christine K., Miriam O., Samuel J. M., Shem W., Ruth A., Vincent O. and John N. (2019). *Mango Propagation*
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Research on innovative investment options for farmers and groups.
2. Gross margins of the hexanal technology

2.7.9 Use of Hot water treatment

2.7.9 TIMP Name	Use of Hot water treatment
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Despite economical and nutritional importance of mango fruits, there is high postharvest loss due to rotting andshort shelf life.
What is it? (TIMP description)	The technology involves dipping freshly harvested mango fruits in water heated at 50-52^{o}C for 5-10 minutes. The treatment is effective in controlling anthracnose. Hot water treatment extend mango fruit shelf life up to 21 days of storage.  Hot water treament
Justification	Postharvest rots is one of the main cause of postharvest losses in mango fruits. Therefore hot water treatment manage rotting of fruits thus extending their shelf life.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and traders/exporters of mango fruits, agri-preneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Increase on postharvest handling trainings for the small scale farmers and traders
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained on use of mango hot water treatment. • Scientists and agricultural extension workers- to provide farmers with knowhow on use of hot water treatment
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega,

	Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and its benefits • Limited awareness of the technology by farmers and traders
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling, if any	Create awareness on the technology
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, farmer groups and individuallead farmers to show benefits of hot water treatment on mango post harvest management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	• Women and youth stand to benefit in use hot water treatments of mangoes
VMG issues and concerns in development, dissemination, adoption and scaling up	• Mango have high commercial potential and, therefore, its promotion and value addition by the VMGs would be expected to improve their lvelhood
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mango. • Use of the technology can reduce postharvest losses and enable VMGs have enough mango to consume, hence get macro- and micronutrients • The grower will also not be forced to make distress sale and will get better return.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mango farmers in Murang'a have used the technology for export market
Application guidelines for users	Factsheets, brochures and manuals on Postharvest handling of Mango from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa**

	Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Validate technology on mango fruits
2. Determine the cost benefit of the technology

2.7.10 Mango waxing Technology

2.7.10 TIMP Name	**Mango waxing Technology**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Despite economical and nutritional importance of mango fruits, there is high postharvest loss due to rotting and short shelf life.
What is it? (TIMP description)	The technology involves dipping mature green mango fruits in 6% bee-carnauba wax for 8 seconds. This results in improved mango shelf life and also quality.  Waxed mango fruits
Justification	Mango fruits perishability is one of the main cause of postharvest losses. Fruits waxing reduces respiration rate of the fruits thus extending the shelf life.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and traders/exporters of mango fruits, agri-preneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Create awareness on the technology to traders and farmers • Availability of markets and good pricing of the fruits.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained on use of waxing of mango fruits • Scientists and agricultural extension workers- to provide farmers with knowhow on use of hot water treatment
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and its benefits • Limited awareness of the technology by farmers and traders
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	• To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, farmer groups and individual lead farmers to show benefits of hot water treatment on mango post harvest management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development,dissemination, adoption and scaling up	Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	Women and youth stand to benefit in use fruit waxing by having employment There is improved food security and nutrition for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Mango have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mango.

	• Use of the technology can reduce postharvest losses and enable plenty availability of mango accessable byVMGs. mango to consume, hence get macro- and micronutrients • The grower will not be forced to make distress sale and therefore will fetch better prices.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mangofarmers in Murang'a
Application guidelines for users	Factsheets, brochures and manuals on Postharvest handling of Mango from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

2.7.11 Modified Atmosphere Packaging of Mango (Ziploc® and Xtend® bag packaging)

2.7.11 TIMP Name	**Modified Atmosphere Packaging of Mango (Ziploc® and Xtend® bag packaging)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to poor packaging
What is it? (TIMP description)	Xtend® bags are modified atmosphere bags characterized by high moisture vapor transmission rates. This assures that excess moisture is eliminated, in the event that condensation forms within the bag. This ensures that the freshness of the fruit is maintained
Justification	The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of mango for between 5-7 days
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and retailers of fresh fruits, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Increase on postharvest handling trainings for the small scale farmers
Partners/stakeholders for scaling up and their roles	• Farmersand retailers groups to be trained in postharvest handling of the mangoes • Scientists and agricultural extension workers- to provide farmers with knowhow on modified atmosphere package Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Lack of knowledge on the technology and the benefits Limited awareness of the technology by farmers and traders
Suggestions for addressing the challenges	• Awareness creation about the technology to farmers and traders • Capacity building of value chain actors on how to use the technology • Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling if any	Continuous training on the benefits of applying the technology
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, farmer groups and individual lead farmers to show benefits of hot water treatment on mango post harvest management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development ,dissemination, adoption and scaling up	Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	Women and youth stand to benefit in use of modified atmosphere packaging
VMG issues and concerns in development, dissemination, adoption and scaling up	• Mango have high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality mango will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.

VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality mango. • Use of the technology can reduce postharvest losses and enable plenty availability of mango accessable by VMGs. mango to consume, hence get macro- and micronutrients • The grower will not be forced to make distress sale and therefore will fetch better prices.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	To be done
Application guidelines for users	Factsheets, brochures and manuals on Postharvest handling of Mango from KALRO
F: Status of TIMP readiness (Ready for up scaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Gross margin of modified atmosphere packaging
2. Comparing MAP with other packaging in terms of shelf life

2.8 Mango Value Addition

2.8.1 Mango Dehydration

2.8.1 TIMP name	Mango Dehydration
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses due to perishability of the mango fruits. Also,mango fruits have short shelf life
What is it? (TIMP description)	This is the process of drying mango pieces in order to prolong the fruit's shelf life. Drying ensures shelf stability and minimizes chemical or physical changes i.e spoilage.  Dehytray
Justification	Short shelf life of mangoes due to its high perishability attribute. Drying of mangoes to extend their shelf life and diversify mango products to increase utilization.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Availability of operating areas with good solar radiation Local artisans can be trained on fabrication, repair and maintenance of facilities used Ensuring sanitary condition when handling mangoes for drying
Partners/stakeholders for scaling up and their roles	Famers- to adopt the technology for usage Artisans - to fabricate the solar dryers, dehytrays

	Workers- to provide farmers with knowhow on solar drying and utilization of solar dried mangoes
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Embu
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of funds to acquire the solar dryers • Challenges in repair and maintenance
Suggestions for addressing the challenges	• Sensitization of the community about high health and nutrition benefits of solar dried vegetables • Provide loans / capital to farmers groups to acquire the solar dryers • Capacity building of local artisans on repair and maintenance
Lessons learned in up scaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the varieties • Availability of market • 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	The technology makes it possible to access the original unprocessed mango off season and enables availability throughout the year for processing to add value.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	Increased income, nutrition Reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth may have limited access to land for cultivation
Gender related opportunities	• The technology has potential of creating employment for women and the youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land
VMG related opportunities	• Mango dehydration is economically viable and is suitable for vulnerable groups
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Solar drying guidelines and brochures from KALRO
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-Mtwapa;

	P.O. Box 16-80109 Email: Kalro.Mtwapa@kalro.org Phone: 0202024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Low information on profitability of Mangoes in the project areas
2. Further research on the efficacy of drying fruits in bulky using dehytray

2.8.2 Mango flour

2.8.2 TIMP name	**Mango flour**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of mango fruits
What is it? (TIMP description) Mango flour	This is flour prepared by milling dried mangoes
Justification	Diversification of mango products will enhance mango consumption and demand thus spur increased production. Mango can be processed to make flour, which can either be fortified or blended with wheat to make variousproducts including biscuits, cakes and other products. Use of mango flour will improve the food and nutrition security.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality Mango, availability of quality standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale mango processing facility

	• Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of mango flour production technology • KEBS – Standards formulation for mango flour, certification of private mango flour processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the Mango flour • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu,
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of the technology by farmers • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities • Majority of the Kenyan lack knowledge on the drying of fruits to make flours which can be used to incorporate several products
Suggestions for addressing the challenges	• Awareness creation about the product to the government agencies, farmers, and traders • Capacity building of farmers on how to use the products • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for its widespread use • Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like mango, focusing on the nutritional quality of mango (gluten-free and rich in minerals). • Working with KEBS to develop standards for Mangoflour • Linking farmers to credit facility providers to get capital to engage in mango flour production agribusiness.
Lessons learned in up scaling, if any	Limited knowledge in appropriate method on drying of fruits
Social, environmental, policy and market conditions necessary for development and up scaling	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. • There is need to develop quality standards for mango flour to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined. To include milling equipment and infrastructures
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of mango
Gender issues and concerns in development, dissemination adoption and scaling up	• Need to empower women and youth agro-processors / entrepreneurs to engage in mango flour agribusiness enterprise.

	• Women can diversify family diet and generate income at village level by making the products for sale
Gender related opportunities	Women and youth stand to benefit in production, use and sale of mango flour.
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced mango flour based products • Nutritious products can be made from mango flour contributing to the nutrition of VMGs
E: Case studies/profiles of success stories	
Success stories	Kitui Royal mango company
Application guidelines for users	Mango flour production 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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Characterizing the various mango varieties for their mango flour yield production potential
2. Research on flour conversion ratio (mango to flour conversion ratio)
3. Research on nutritional content of mango flour and the derived value added mango - based products
4. Research on technological and food processing properties of mango flour (water absorption capacity, rheological properties, pasting characteristics, etc.)
5. Conduct business and economic analyses of mango flour production and target markets for mango 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 mango flour and mango flour based products

2.8.2 Mango Pulp

2.8.2 TIMP name	Mango Pulp
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Diversifying mango processed product to enhance on their uses and markets.
What is it? (TIMP description)	Mango pulp is the inner fleshy yellow, sweet part of the mango. It is processed by peeling mango, slicing and then blending or use fruit pulper to make the mango pulp. The mango pulp is pasteurized to enhance storage life. Themango pulp can be used to make mango jam, juice, leather, and others.  Mango pulp
Justification	Mango fruit is highly perishable resulting to postharvest losses and short shelf life. Processing of mango fruits into various products enhances shelf life thus ensuring availability during off season. Agro- processing adds value to the fruits, and increases their economic value thus giving better returns to farmer or various value chain actors. Processing mango into pulp also diversify market and usage of mango.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process

	mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango pulp production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, JKUAT and UON – will train trainers and provide technical backstopping on dissemination of mango pulp production. • KEBS – Standards formulation for mango pulp; certification of private mango pulp processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango pulp
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Kitui, Makueni
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	Mango pulp processing requires good hygiene, sanitation and deionized water
Social, environmental, policy and market conditions necessary for development and up scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for takingup mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of juice and nectars

Gender related opportunities	Women and youth stand to benefit in mango processing into pulp
VMG issues and concerns in development, dissemination adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Mango pulp processing and consumption by VMGs hence bettering their health and incomes
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume mango pulp
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango pulp production leaflets and manuals by KALRO
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Data on mango pulp gross margin

2.8.4 Mango Juice

2.8.4 TIMP name	**Mango Juice**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Mango fruits are highly perishableand therefore processing into juice will reduce postharvest losses,enhance their shelf life, diversify their utilization and markets
What is it? (TIMP description)	Mango juice is prepared from mango pulp and it is pasteurized to enhance storage life.  Mango juice

Justification	Diversification of mango products will enhance consumption of mango, enhance demand and thus spur increased production. The mango which have a sweet taste, fine flavor and texture can be processed into juice for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango juice production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and UoN – will train trainers and provide technical backstopping on dissemination of mango juice production. • KEBS – Standards formulation for mango juice; certification of private mango juice processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango juice
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui, Kiambu, Machakos, Embu, Tharaka nithi
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products

Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product - Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	• There is need for aggregation centres for consistentof the mango juice
Social, environmental, policy and market conditions necessary for development and up scaling	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for takingup Mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of fresh fruit juices • Has the potential of creating job opportunities for the youth
Gender related opportunities	• Women and youth stand to benefit in mango processing into pulp, offering food security and nutrition • Has the potential of providing jobs for women and the youths
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango pulp • Has the potential of providing food security and nutrition for the VMG
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango juice production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org

	Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Fine-tuning the production protocol and packaging
2. Determining market demand and gross margins
3. Characterize different mango varieties for their nutritional composition and suitability in processing various value-added products (flour, pulp, juice)

2.8.5 Prickled Mango

2.8.5 TIMP name	**Prickled Mango**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Mango perishability that lead to postharvest losses and limitedmango products
What is it? (TIMP description)	Pickle are prepared from mature mangoes which are sliced into equal sizes and packed in containers filled with white vinegar
Justification	Diversification of mango food products will enhance consumption of mango, enhance demand and thus spur increased production. The mango which have a fine flavor and texture can be processed into pickle for both domestic use and sale. This will also reduce postharvest losses and also enhance productivity
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of cottage processing units into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango pickle production. They will

	also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of mango pickle production. • KEBS – Standards formulation for mango pickle; certification of private mango pickle processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango pickle
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru, Tharaka Nithi
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product - Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	Create awareness on preparation and utilization of the products
Social, environmental, policy and market conditions necessary for development and up scaling	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. • There is need for the government to facilitate affordable credit to empower farmers for taking up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of fries and salads
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product

	• Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango pickles • Has the potential of offering diversified livelihood for the VMG • Offers improved food security and nutrition to households that may have VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango pickle production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Gathambiri C., Ndambuki J., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Characterizing the various mango varieties for their mango pickle production potential (for example, which variety produces the best pickle)?
2. Optimizing the pickle production procedures

2.8.6 Mango Chutney

2.8.6 TIMP name	**Mango Chutney**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Occurrence of postharvest losses due to mango perishabilityand there are limitedmango products

What is it? (TIMP description)	Chutney are prepared from mature mangoes and not overripe. It is made by shredding of the mango fruits after and frying them, mixed with any and some of the following: tomatoes, pepper, garlic, ginger, onions, oils and mustard seed.  Mango Chutney
Justification	Processing of mango fruits to chutney will reduce postharvest losses and also increase mango processed products that leads to enhanced consumption of mango, enhance demand and thus spur increased production. Mango fruits which have a fine flavor and texture can be processed into chutney for both domestic and export markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and households, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Capacity building of stakeholders, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango chutney processing. They will also offer advice and collect information on the uptake and practice on the technology • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango chutney
C: Current situation and future scaling up	
Counties where already promoted, if any	Not yet
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu,

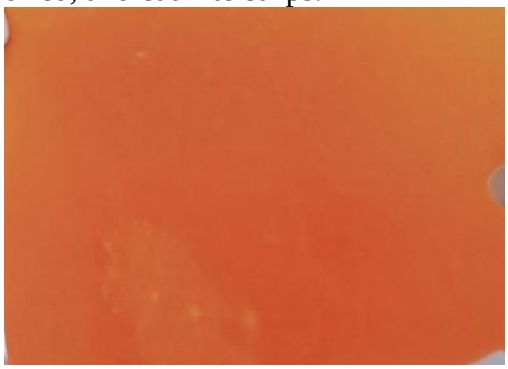
	Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	Stakeholders learnvbest when they see and participate in Value addition activities.
Social, environmental, policy and market conditions necessary for development and up scaling	- Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for takingup mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango pickles

	• Offers improved food security and nutrition to households, who may have VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango chutney production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Providing data on market demand and gross margins

2.8.7 Mango Leather

2.8.7 TIMP name	**Mango Leather**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses due to perishability of mango fruit and limitedmangoprocessed products
What is it? (TIMP description)	Mango leather is prepared from mature ripe mango. It's a sweet food made from mango that has been crushed and then spread out, dried, and cut into strips.  Mango Leather

Justification	Diversification of mango processed products will enhance consumption of mango, enhance demand and thus spur increased production. The mango seed coat has fine texture that can be processed into mango leather for both domestic and export market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services"
Critical/essential factors for successful promotion	Participatory implementation, availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango leather production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of mango leather production. • KEBS – Standards formulation for mango leather; certification of private mango leather processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango leather products
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product

	• Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added Mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for taking up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango leather processing leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Ready for up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa**

	Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Characterizing the various mango varieties for their mango leather production potential (for example, which variety produces the best mango leather)
2. Optimizing the mango leather production procedures
3. Providing data on gross margins and market demand for mango leather production

2.8.8 Mango Jam

2.8.8 TIMP name	**Mango Jam**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• High postharvest losses and limited value added products of mango fruits
What is it? (TIMP description)	Mango jam is prepared from mature mango. It's made by washing, peeling, cutting into small chunks, blending into pulp, mixing with sugar and lemon, heating until it forms a thick consistent paste, then packaging in hot jars.  Mango Jam
Justification	Diversification of mango processed products will enhance consumption of mango, enhance demand and thus spur increased production. The mango fruit has a fine flavor and texture. It can be processed into mango jam for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days

	• Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality Mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango jam production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of mango jam production. • KEBS – Standards formulation for mango jam; certification of private mango jam processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango jam
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Machakos, Makueni, Tharaka Nithi, Kitui
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers

Lessons learned in up scaling, if any	To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for taking up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women may have less access to agricultural information, technology and knowledge • Women and youth may have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth may have limited access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production and trade of the product • Has the potential of offering diversified livelihood for women and youth Offers improved food security and nutrition to households Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Has the potential of offering diversified livelihood for VMGs • Offers improved food security and nutrition to households • Offer employment to the VMGswomen and youth • Opportunity for VMGs to produce, trade in, and consume mango jam
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango jam production factsheets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Ready up scaling
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.

Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Research Gaps

1. Data on mango jam gross margin

2.8.9 Mango chips

2.8.9 TIMP name	**Mango chips**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited mangoprocessed products that would enhance utilization andincome Occurrence of postharvest losses
What is it? (TIMP description)	Mango chip is made from firm and ripe mango. The mango is washed, peeled, sliced into equal portions, dipped in treated solution dried and packaged in air tight containers. It is consumed as a snack.  Mango chips
Justification	Diversification of mango food products will enhance consumption of mango, enhance demand and thus spur increased production. The mango which has a fine flavor and texture can be processed into mango chips for both domestic use and sale. Processing mango fruit into chips will reduce postharvest losses
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "Shamba Shape Up"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.

Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on Mango chips production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of mango chips production. • KEBS – Standards formulation for mango chips; certification of private mango chips processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango chips
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for takingup mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of fries and samosas

Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango chips • Has the potential of offering diversified livelihood for VMGs • Offers improved food security and nutrition to households, some of which may have VMGs • Offers employment to the VMGs
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango chips production leaflets and manuals by KALRO
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Commercialization and gross margin of mango chips

2.8.10 Mango Wine

2.8.10 TIMP name	Mango Wine
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses and limited value addition of mango fruits
What is it? (TIMP description)	Mango wine is made from ripe mangoes. This done by mixing the pulp with enzyme pectinase, sugar and yeas. The mixture is then fermented for 45 days, filtered and packed.  Mango wine
Justification	Diversification of mango processed products will enhance consumption of mango, enhance demand and thus spur increased production. The mango which have a fine flavor and texture can be processed into mango wine for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality

	standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango wine production. They will also offer advice and collect information on the uptake and practice of the technology • KALRO and UoN – will train trainers and provide technical backstopping on dissemination of mango wine production. • KEBS – Standards formulation for mango wine; certification of private mango wine processors
C: Current situation and future scaling up	
Counties where already promoted, if any	Tharaka Nithi, Embu
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added Mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for takingup mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development, dissemination adoption and scaling up	• Access and control of land for women is limited • Women may have less access to agricultural information, technology and knowledge • Women and youth may have limited finances to purchasein putsdue to limited access tocreditfacilities • Women and youth may have limited access to education, training and extension services than men
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango wine • Has the potential of creating job opportunities for the youth • Has the potential of providing food security and nutrition for the VMG • Has the potential of offering diversified livelihood for PLWD and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• Mango wine production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Require validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org' Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Data on market demand of mango wine and gross margin

2.8.11 Mango Toffee

2.8.11 TIMP name	Mango Toffee
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	• High postharvest losses and limited utilization of mango fruits
What is it? (TIMP description) Mango Toffee	Mango toffee is a kind of firm or hard sweet which softens when sucked or chewed, made by boiling together mango pulp, sugar and butter, often with other ingredients or flavorings added.
Justification	The narrow range of mango products calls for diversification. Processing mango toffees will diversify mango use and enhance consumption. This will enhance demand and thus spur increased production of mangoes
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality Mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process Mango into various products; The government should facilitate affordable credit to empower farmers take up Mango agribusiness.
Partners/stakeholders for scaling up and their roles	County government and private extension service providers will train farmers on mango toffees production. They will also offer advice and collect information on the uptake and practice on the technology KALRO, UON and JKUAT – will train trainers and provide technical backstopping on dissemination of mango toffees production. KEBS – Standards formulation for mango toffees; certification of private mango toffees processors Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango toffees
C: Current situation and future scaling up	
Counties where already promoted, if any	None

Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product - Information dissemination • postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for taking up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to land for the crop's cultivation than men. • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit allwomen and youth
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth

VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit VMGs
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango toffees • Has the potential of creating job opportunities for the youth • Has the potential of providing food security and nutrition for the VMG • Has the potential of offering diversified livelihood for VMG • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango toffees production leaflets and manuals
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Mango varieties best for toffee production

2.8.12 Mango Yogurt

2.8.12 TIMP name	
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Diversifying mangoprocessed products to enhance utilization andincome

What is it? (TIMP description)	A snack food product made from mango-milk. The milk is fermented then blended with the mango pulp. Its served as natural or sweetened and served as a snack.  Mango Yogurt
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mango.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango yogurt production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of mango yogurt production. • KEBS – Standards formulation for mango yogurt; certification of private mango yogurt processors

	• Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango yogurt
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers for taking up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside shops of yogurt and milk
Gender related opportunities	Women and youth stand to benefit in production and trade in the product
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit VMGs
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango yogurt
E: Case studies/profiles of success stories	
Success stories	

Application guidelines for users	Mango yogurt production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University Colleges, MoALF, NGOs, CBOs

Gaps

1. Nutritional analysis of mango yogurt

2.3.10 Mango Candy

2.8.13 TIMP name	**Mango Candy**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Diversifying mangoprocessed products to enhance utilization andincome
What is it? (TIMP description)	A snack food product made from mango pulp and sugar. These chewy fruit squares are vibrant with the fresh taste of mango.  Mango Candy
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mango.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
• Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango candy production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of mango candy production. • KEBS – Standards formulation for mango candy; certification of private mango candy processors • • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango candy
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product

	• Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside shops of sweets and toffees
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offers employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit all VMGs
VMG related opportunities	• Has the potential of creating job opportunities for the VMGs • Has the potential of providing food security and nutrition for the VMG • Has the potential of offering diversified livelihood for VMG • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
E: Case studies/profiles of success stories	
Success stories	To be documented
Application guidelines for users	Mango candy production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org

	Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University and Colleges, MoALF, NGOs, CBOs

Gaps

1. Data on gross margin of mango candy

2.8.14 Mango Nectar

2.8.14 TIMP name	**Mango Nectar**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses and limited utilization of mango fruits
What is it? (TIMP description)  Mango Nectar	Mango nectar is a non-carbonated beverage flavored by pulp from mangoes. It is yellowish orange in color and has a smell similar to that of fresh mango. Mango nectar is used as an ingredient to flavor mixed cocktails.
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mangoes. This will also lead to reduced postharvest losses
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango nectar production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of mango nectar production. • KEBS – Standards formulation for mango nectar; certification of private mango nectar processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango nectar
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for

	value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside shops of sweets and toffees
Gender related opportunities	Women and youth stand to benefit in production and trade in the product
VMG issues and concerns in development, dissemination adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango nectar
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango nectar production leaflets and manuals by KALRO
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University and Colleges, MoALF, NGOs, CBOs

Gaps

- Data on mango nectar gross margin
- Nutrient analysis of mango nectar

2.8.15 Canned Mango

2.8.15 TIMP name	Canned mango
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses and limited utilization of mango fruits
What is it? (TIMP description) Canned mango (source:internet)	Canned mango is a snack made up of mango fruit and sugar syrup. 
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mangoes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on canned mango production. They will also offer advice and collect information on the uptake and practice on the technology

	• KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of canned mango production. • KEBS – Standards formulation for canned mango; certification of private canned mango processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the canned mango
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels

	• Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit allwomen and youth
Gender related opportunities	Women and youth stand to benefit in production and trade in the product Women and youth stand to benefit in production and trade in the product Has the potential of offering diversified livelihood for women and youth Offers improved food security and nutrition to households Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VGMs have low finances due to limited access tocredit facilities • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit all VMGs
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume mango • Has the potential of creating job opportunities for the VMGs (youth, PLWA,elderly and PLWD) • Has the potential of providing food security and nutrition for the VMG • Has the potential of offering diversified livelihood for VMG • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Canned mango production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University and Colleges, MoALF, NGOs, CBOs

Gaps

1. Data on canned mango gross margin

2.8;18 Mango Salad

2.8.16 TIMP name	Mango salad
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information and skills on mango salad processed product. Diversifying mangoprocessed products to enhance utilization andincome
What is it? (TIMP description)	Mango salad is a cold recipe of various mixtures of raw mango and vegetables, usually seasoned with vinegar.  Mango salad (source:internet)
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mangoes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should facilitate affordable credit to empower farmers take up mango agribusiness.

Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango salad production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of mango salad production. • KEBS – Standards formulation for mango salad; certification of private mango salad processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango salad
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	
Social, environmental, policy and market conditions necessary for development and up scaling	- Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers. There is need for the government to facilitate affordable credit to empower farmers take up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside shops of sweets and toffees

Gender related opportunities	Women and youth stand to benefit in production and trade in the product
VMG issues and concerns in development, dissemination adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
VMG related opportunities	• Opportunity for VMGs to produce, trade in, and consume mango salad
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango salad production leaflets and manuals by KALRO
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 – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751
Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University and Colleges, MoALF, NGOs, CBOs

Gaps

1. Data on mango salad gross margin and market demand

2.8.17 Mango Ice cream

2.8.17 TIMP name	Mango Ice cream
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Diversifying mangoprocessed products to enhance utilization andincome
What is it? (TIMP description)	Mango icecream is a soft, sweet frozen food made with milk, mango pulp and cream and it is flavoured with mango.  Mango Ice cream (source: honest cooking)
Justification	Diversification of mango value added products will enhance consumption of mango, enhance demand and thus spur increased production of mangoes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality mangoes, availability of quality standards; Farmers should organize themselves into growers' associations which facilitate setting up of factories to process mango into various products; The government should

	facilitate affordable credit to empower farmers take up mango agribusiness.
Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on mango Ice cream production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO, UON and UoN – will train trainers and provide technical backstopping on dissemination of mango Ice cream production. • KEBS – Standards formulation for mango Ice cream; certification of private mango Ice cream processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the mango Ice cream
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of product by farmers and consumers; limited processing technology at the household level. • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added mango products
Suggestions for addressing the challenges	• Awareness creation about the product to farmers, consumers and other value chain actors. • Capacity building of farmers on how to prepare the product • Information dissemination • Postharvest handling, value addition, and nutritional attributes of the product • Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added mango products; nutrition education to consumers
Lessons learned in up scaling, if any	To be documented
Social, environmental, policy and market conditions necessary for development and up scaling	To target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers. There is need for the government to facilitate affordable credit to empower farmers take up mango agribusiness
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have limited access to land for the crop's cultivation than men. • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit allwomen and youth
Gender related opportunities	• Women and youth stand to benefit in production and trade in the product • Has the potential of offering diversified livelihood for women and youth • Offers improved food security and nutrition to households • Offer employment to women and youth
VMG issues and concerns in development, dissemination adoption and scaling up	• VGMs have low finances due to limited access tocredit facilities • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Theproducthas high commercial potential and, therefore, its promotion and value addition will benefit all VMGs
VMG related opportunities	• Has the potential of creating job opportunities for the VMGs (youth, PLWA,elderly and PLWD) • Has the potential of providing food security and nutrition for the VMG • Has the potential of offering diversified livelihood for VMG • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Mango Ice cream production leaflets and manuals by KALRO
F: Status of TIMP readiness (1-Ready for up scaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO – Industrial Crop Research Institute, Mtwapa P.O. Box 16-80109. **Mtwapa** Email: director.icri@kalro.org Phone: 020-2024751

Lead organization and scientists	KALRO Ndambuki J., Gathambiri C., Wayua F., Pole F., Kirigua V. and Wasilwa L.
Partner organizations	Agricultural University and Colleges, MoALF, NGOs, CBOs

Gap
1. Data on mango ice cream gross margin and market demand

2.9 Mechanization of Mango Production Activities

2.9.1 Power Tiller

2.9.1 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 mango commodity • Difficult to prepare a uniform fine tilth seedbed manually • Drudgery leads to low acreage • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)	A Power tiller is a low powered two-wheeled agricultural implement, also referred to as a walking tractor. They range from 8-16hp that can be fitted with implements such as a rotary tiller, disk harrow, mouldboard plough, trailer, chisel or water pump at alternate times for easing farm operations. It can complete one hectare in two hours per operator. This will vary depending on the climatic conditions, soil types, soil moisture content, operator stamina and experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability or aptitude of the operator.
Justification	A Power Tiller can be used in seedbed preparation, sowing seed, planting seed, spraying of fertilizer or herbicide and even irrigation. In addition, can also be used for threshing and

	transporting produce. A power Tiller is ideal where the land size is small. Farm sizes less than one hectare may limit maneuverability of conventional tractors and manual labour is costly to maintain apart from being slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of the TIMP	Mango farmers and researchers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of Mango value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	• KALRO, Universities (for information) • Machinery fabricators • NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where the TIMP is already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Baringo, Machakos
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
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	• Gender Unfriendly and expensive machines • Mango machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Facilitation to access information • Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
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 up scaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
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 and Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

2.9.2 4 Wheeled Tractor 50Hp

2.9.2 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 beaddressed	• Slow and tedious processes of seedbed preparation, in a commercialized Mango commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)	A small sized, 4 wheeled tractor is a low powered agricultural implement of 40-55hp that can be fitted with a rotary tiller, disk harrow, mouldboard plough, trailer, chisel or water pump at alternate times for easing farm operations. It can do 4 hectares per day by one operator but can have two operators to run another 8 hours of 4 hectares, thus coming to 8 hectares 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 hectare. 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 s, sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for threshing through a power take off device and transporting produce. Farm sizes less than one hectare may limit maneuverability of conventional tractors yet manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango farmers and researchers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to evaluate and recommend the tractor for small scale farmers. • A platform for interaction of mango value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	• KALRO, Universities (for information) • Machinery dealers • NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Baringo, Machakos
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of tractors • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish a 4-wheeled innovation platform • Acquisition of the machines • Lack of facilitation to demonstration site • Build financial capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Chances of successful up-scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
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	• Women have less access to agricultural information, technology and knowledge

	• Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services • Gender Unfriendly and expensive machines • Mango machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Makes work easy for the VMG
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	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 up scaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
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 and Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

2.9.3 Mouldboard Plough

2.9.3 TIMP Name	Mouldboard Plough
Category (i.e. technology, innovation or management practice)	***Technology*** 
A: Description of the technology, innovation or management practice	
Problem to beaddressed	• Slow and tedious processes of seedbed preparation, in a commercialized mango 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 an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation.
Justification	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, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	• KALRO, Universities (for information) • Machinery fabricators • NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Baringo, Machakos
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
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	• Gender Unfriendly and expensive machines • Potato machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth

	• Reduces drudgery for women farmers as well as men • With mechanization the production goes up improving food security and nutrition forhousehold members
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Reduces drudgery for VMG farmers • With mechanization the production goes up improving food security and nutrition for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	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 up scaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
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, Pole F.N. Nasirembe W.,
Partner organizations	Local Fabricators

2.9.4 Disk Harrow

2.9.4 TIMP Name	Disk Harrow
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to beaddressed	• Slow and tedious processes of seedbed preparation, in a commercialized mango commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)	It is an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up clods, remove weeds, cover seed and is a cultivating tool set with used primarily for breaking up and smoothing the soil in preparation of a seedbed
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 Improves nutrient availability to plants.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango farmers and researchers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Makueni, Kitui, Baringo
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
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	• Gender Unfriendly and expensive machines • Mango machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• Facilitation to access information • Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	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 up scaling;, 2-requires validation; 3-requires further research**)**	Ready for up scaling
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 and Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.9.5 Hole drill

2.9.5 TIMP Name	**Hole drill**
Category(technology, innovation or management practice)	Technology 

A: Description of the technology, innovation or management practice	
Problem to be addressed	High and increasing cost of manual labour. Manual digging increases the cost of making planting holes. It is a slow and tedious process. Delayed operation lead to late planting.
What is it? (TIMP description)	Hole digger is a power take off (PTO) driven machine that augers holes in rows at equal distances mechanically and economically. It also can be used for hole making for electric poles and farm hedges. It is best suited for tree plantations. It can auger down to about 90cm deep with even diameter in just 30 seconds.
Justification	The auger makes a definite and uniform hole diameters and depths as desired selected from the auger specifications. Users spend 50 times shorter a time and as little as 90ml to auger a hole. It is augers as it removes detached soil forming a much neater hole, with a well-defined circumference. Holes can be made at pre-defined by driving the compact tractor. It is easy to use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango farmers and researchers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive research to evaluate and recommend • A platform for interaction of mango value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Kilifi, Kwale, Lamu
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines

Suggestions for addressing the challenges	• Establish Mango innovation platforms • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 40,000 (power auger digger), KES 80,000 (Tractor mounted hole digger)
Estimated returns	KES 20,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have less access to agricultural information, technology and knowledge • Women and youth may have limited finances to pay services and to purchase farm equipmentdue to limited access to credit facilities • Women and youth may have limited access to education, training and extension services than men • Gender Unfriendly and expensive machines • Mango machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand 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	• User manuals and leaflets
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 and Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

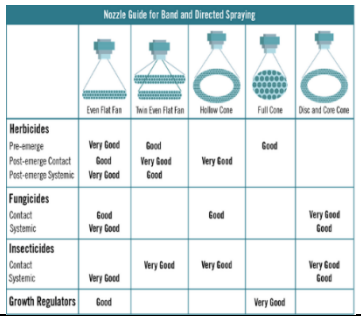
2.9.6 Backpack weeder

2.9.6 TIMP Name	**Backpack weeder**
Category(technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Manual weeding is slower and untimely • Availability of manual labour is diminishing
What is it? (TIMP description)	Backpack weeder weighs about 6 kg. It iscarried on the back like a Backpack and its blades are directed to the weeding area and has capability of weeding about 1 ha of land in a day which is equivalent to the amount of work done by 10 People on the same farm in a day.A feature, apart from the issue of their easy transportation, is that it keeps operators balance and while working, the operator focuses more on work and eliminate weeds.
Justification	• It is cost effective compared to manpower • Weeding is the most tedious seasons in farming and employing 10 farm workers will definitely cost more.

	• Ease of use to work with • Tremendously increases the possible acreage cultivayted
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services •
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release improved mango varieties
Partners/stakeholders for scaling up and their roles	Machinery fabricators, NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	To be documented
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	
Estimated returns	Not yet
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may have less access to agricultural information, technology and knowledge • Women and youth may have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth may have limited access to education, training and extension services than men • Gender Unfriendly and expensive machines • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level • Creates employment especially for yout
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	• User manuals • Leaflets
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 AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO and Egerton University, Nasirembe W, Pole F.N.
Partner organizations and contacts	Local Fabricators

2.9.7 Motorised Sprayer

2.9.7 TIMP Name	Motorised Sprayer
Category(technology, innovation or management practice)	Technology  
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of manual spraying of mango; The height of the tree requires a long projectile spray which cannot be attained by a manual knapsack; Mango has a high number of pests that invade leaf, flowers and nut.
What is it? (TIMP description)	In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops.A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of the chemical, weed killers, crop performance enhancement materials including fertilizers and pest control chemicals.
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before mango forms a canopy, broad leafed weeds compete with mango seedling for nutrients and light greatly reducing their yield. Manual sprayers are labourintensive while spraying labour is too expensive. It has lower pressure reducing its efficiency hence a motorized knapsack comes in handy.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message service
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Accceptance and Use by Farmers

Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Kilifi, Kwale, Taita Taveta, Lamu
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively high cost for individual small-scale farmer. • Limited awareness of the existence of machine among some farmers.
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • 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 designed for easy start and operation. Men have been drawn to spraying by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
Gender related opportunities	• Creates employment especially for youth • Reduces drudgery for all gender
VMG issues and concerns in development, dissemination, adoption and scaling up	• Facilitation to access information • Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• User manuals and leaflets

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 and Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Motorized sprayer designed for easy start and operation. Men have been drawn to spraying by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
Gender related opportunities	
VMG issues and concerns in development, dissemination, adoption and scaling up	• Facilitation to access information • Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

2.9.8 Power tree pruner

2.9.8 TIMP Name	Power tree pruner
Category(technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Manual pruning is slower and untimely • Manual pruning requires a ladder that increases cost of pruning and also subjecting the pruner to danger of falling • Manual labour is diminishing escalating its cost
What is it? (TIMP description)	A powered Pole Tree Pruner consists of a small chainsaw mounted on a long shaft, enabling the operator to cut through high tree branches while standing at ground level. Power pruners are used to make smaller cuts on branches or shrubs. As the name suggests, pruners are used to prune trees. Less powerful than chainsaws, the cutting diameter of power pruners will be smaller as the chain guide is shorter. A power pruner is basically a motorised version of a manual pole pruner or branch cutter.
Justification	• The machine works faster, has a low engine capacity of less than 30cc. • The machine is telescopic and can reach far end branches at will. • Uses gasoline available in remote sites • Discourages child labour
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals

	• Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • 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	
Estimated returns	Not yet
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may have less access to agricultural information, technology and knowledge • Women and youth may have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Gender Unfriendly and expensive machines • Farm machines should be designed for easy start and operation. • Up-scaling should target all the gender • Gender Unfriendly and expensive machines

	• Mango machines should be designed for easy start and operation. • Up-scaling should target all the gender • Affordability to all gender
Gender related opportunities	Creates employment especially for youth Reduces drudgery for all gender
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP • Linking the VMG to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
VMG related opportunities	• Can create employment for VMG at local level
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	• User manuals • Leaflets
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 AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO and Egerton University, Nasirembe W, Pole F.N.
Partner organizations and contacts	Tecsols Ltd – Nakuru
VMG issues and concerns in development, dissemination, adoption and scaling up	• Training on local use and transportation will make it more usable. • Power tree prunner is affordable and could help VMGs exploit
VMG related opportunities	Can create employment for VMG at local level
G: Contacts	
Contacts	The Institute Director KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO and Egerton University,

	Nasirembe W, Pole F.N.
Partner organizations and contacts	Tecsols Ltd – Nakuru

2.9.9 Grafting robot

2.9.9 TIMP Name	**Grafting robot**
Category(technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Lack of mango grafted planting material • High cost of labour • Manual labour is diminishing • Grafting success rate is high
What is it? (TIMP description)	An automatic grafting robot is a to which can implement clipping, moving, positioning, cutting, binding, and wrapping rootstock and scion saplings. Experimental results indicate that the grafting success rate of this robot is 87.3% and the binding success rate is 68.9%.
Justification	Robot automatically grafts species that guarantee rich and high-quality harvesting and are strong against diseases. By using robot technology, hand labour can be eliminated. The whole idea of grafting is to combat soil-borne diseases by using two types of rootstock.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Acceptance by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • 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	To be determined
Estimated returns	To be determined
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Mango grafting robot designed for easy start and operation by all gender.
Gender related opportunities	Employment opportunitiesexistforyouthinoperation and maintenance of the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP

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

2.9.10 Grafting Tool

2.9.10 TIMP Name	**Grafting Tool**
Category (technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of mango grafted planting material. High cost of labour since availability of manual labour is diminishing
What is it? (TIMP description)	A grafting tool works perfect on hardy plants, especially on fruit trees. This tool is designed with cutting groove on cutting board. It is easy for one to prune branch into U shape, V shape and wedge shape. Its handles are made from ABS plastic, the rest parts and blades are made from high carbon steel orchrome treated for durable sharp.
Justification	Grafting allows the gardener to provide a longer growing season and a greater diversity of plant varieties. Despite being Labour

	intensive, grafting is commonly undertaken as a means of vegetative propagation of woody plants for any or all of the following reasons: (1) to impart disease resistance or hardiness, contributed by the rootstock; (2)they are more vigorous and grow slightly larger.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services •
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Establish Mango innovation platforms
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.

necessary for development and up scaling	• Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Mango grafting tool is designed for easy start and operation. Up-scaling should target all the gender Affordability to all gender
Gender related opportunities	• Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services and to purchase farm equipmentdue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men • Men dominate most decisions at the household and community levels • Gender Unfriendly and expensive machines • Farming machines should be designed for easy start and operation. • Up-scaling should target all the gender • The is needto equipwomen, youth and stakeholders withinformationrelating to the TIMP • Linking thewomen and youth to financial institutions wouldenable them to buy since it isaffordableand easy to maintain machines
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may have less access to information, extension services, training, education, inputs, credit and land • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs need to be equipped withinformationrelating to the TIMP • 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
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	User manuals and leaflets
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos

	Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO and Egerton University, Nasirembe W, Pole F.N.
Partner organizations and contacts	Local Fabricators

2.9.11 Towable Boomlift Harvesting machine

2.9.11 TIMP Name	**Towable Boomlift Harvesting machine**
Category (technology, innovation or management practice)	 Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Manual pruning is slower and untimely • High cost of labour • Food and water is used as fuel • Manual labour is diminishing
What is it? (TIMP description)	Towable boom lift offers ease of operation and transportation to your work site. For use in painting, signwriting, tree topping, overhead lighting, factory maintenance, cleaning, and general overhead work. Some models are fitted with a jib boom which gives the ability of up and over positioning capabilities allowing for access to the most difficult work sites
Justification	• The machine works faster • The machine is telescopic and can reach far end branches • Canbeattachedtoatractorthatusesgasolineas fuel • Discourages child labour • Cost effective
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Mango Farmers and agribusiness entrepreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days

	• Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction of mango value chain stakeholders • Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(e.g. AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Kilifi
Counties where TIMP will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of mango innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Establish Mango innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • 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	Mango thresher 125,000 KES per unit
Estimated returns	Capacity 500 kg/ hour, Fuel 1 litre /hr (4-5 bags) Needs 3 operators per time Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination,	• Womenperformmostofthecropproductionactivities,therefore the implement will reduce theirdrudgeryof work

adoption and scaling up dissemination	• Womenandyouthmay havelimitedaccessto credittopurchasethe required implements • Womenandyouthmay havelimitedaccesstoeducation,trainingand extension services • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	The pruner is designed for easy start and operation.
VMG issues and concerns in development, dissemination,adoption and scaling up	• VMGshavelimited accesstocreditto purchasethe implement • VMGshavelimited accesstotrainingandextension services • DuetotheirsocialstatusVMGsareoftenexcludedfromdecisio n making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMGrelated opportunities	OpportunitiesexistforunemployedVMGs inoperatingthe implement
E: Case studies/profiles of success stories	
Success stories from previous similarprojects	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 and Egerton University, Nasirembe W,
Partner organizations	Local Fabricators

2.10 Mango Farming Business and Marketing Practices

2.10.1 Transformative market-oriented Model of Mango production

2.10.1 TIMP Name	**Transformative market-oriented Model of Mango production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Dominance of household subsistence level of mango production
What is it? (TIMP description)	An approach to organize avocado production based on market orientation using models. Producer–drive nmodel is based on

	production organized by the producers themselves. Buyer-driven model is based on production organized by the customers or companies. Intermediary- drive nmodel is based on the production organized by an intermediary such as extension services providers, NGOs and Research institutions.
Justification	There is need to have commercial oriented approach and organization of a mango production. Farmers should havemarkets, leading to motivation to produce for income and wealth creation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Acceptance of smallholder farmers to produce mangoes • Availability of investors • Prices of mango • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – investments in mango production • County extension staff- Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local traders and exporters) – Support in input services and providing markets for the mango production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Group dynamics

	• Limited investment by buyers • Prices of mango • Level of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of marketing groups • Small-scale farming – Aggregation of production • Group dynamics – Capacity building • Limited investment by buyers – County government support • Prices of mango – Setting minimum price • Level of policy support – price policy, subsidies, inputs support
Lessons learned in up scaling if any	• Production of mango without agreed buyers • Individual marketing instead of collective marketing
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability by the farmers, group dynamics, cultures • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, investment environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of participation in marketing forums
Estimated returns	Good prices and high turnovers leading to increased income
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is usually a men enterprise and women are generally discriminated in rural producer organizations. • 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	• Increase in production and sales by youth, females and males in the production of mango leading to food security and nutrition • Men and youth stand to benefit with higher profit margins through collective bargaining during transformativemarketing
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	• Income generation using farmer-market linking models • Access to inputs and markets through linkages and producer organization
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 areavailable

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The models are ready for up-scaling
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- Dr. Wambua, J.M.
Partner organizations	

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 farmer-market linking models
4. Farmer accessibility to production inputs

2.10.2 Preparation of a Business Plan for mango production

2.10.2 TIMP Name	**Preparation of a Business Plan for mango production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of business plans for the mango agro-enterprise and market development
What is it? (TIMP description)	A mango business plan will serve as an internal management and organizing tool, be used to communicate outside your business, or both
Justification	With a business plan in hand, mango farmers and rural entrepreneurs will be able to take that first step toward the creation of a successful and sustainable business.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors, agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Education levels of the farmers and investors in mangoproduction • Levels of experiences in mango production • Availability of information on mango production and marketing • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Users of business plans • County extension staff- Capacity building • NGOs – Capacity building • Private sector (local traders, exporters) – Buyers of mango • Research institutions – Capacity building • Financial Institutions – Financial support
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on mango production and marketing • Inadequate levels of policy support •
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the mango production – Developing information hub • Level of policy support – support in extension services • Levels of education – Capacity building
Lessons learned in up scaling if any	• Low adoption of business planning
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptable in Counties growing mango • Environmental conditions – Availability of water resources • Policy conditions – Policy support in opportunities selected
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of participation in marketing forrums
Estimated returns	Good prices and high turnovers leading to increased income
Gender issues and concerns in development and dissemination, adoption and scaling up	• Women are widely discriminated in rural producer organizations

	• Women also have limited participation and influence in rural producer organizations • Socio-culturalnormsmaylimitwomen'sparticipationand leadership in groups • Women'sdoubleandtriplerolesmeansthey may nothave time to participate • Women'sstatus,age,wealthlevelmayinfluence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women maynot be able to travel awayfrom their homes to producer group meetings, without permission
Gender related opportunities	• Increasd management skills among youth, women and men • Increased profitability • Improved access to market within and without • Increased market information and channels for women and youth hence increased job opportunities
VMG issues and concerns in development and dissemination, adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs also have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join
VMG related opportunities	• Increased profitability • Improved access to market within and without • Increased market information and channels for 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 areavailable
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The matrices are ready for up-scaling
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 Dr Wambua J. N.
Partner organizations	

GAPS

Further research

1. Impact of business plan on mango production
2. Adoption of business plan

2.10.3 Collective marketing

2.10.3 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	Individual farmer marketing increases inaccessibility to markets due to low volumes and lack of market power leading to low prices
What is it? (TIMP description)	Marketing as a group is a collective marketing approach. It involves formation of a group of farmers with an objective of reducing market inaccessibility.
Justification	Due to small-scale farming of mango, marketing as a group would enable farmers to gain from economies of scale. The advantages of collective marketing are bigger volumes, uniform quality, reliable sellers, reliable buyers, continuous supply, higher price and organization
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers,tradersand processors, agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Production programme outlined • Sell their produce before the collective sale • Failure of the farmer to meet the agreed delivery amount to the group • Control of side-selling-abiding by collective agreements • Favourable weather • Control of quality standards • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Defining production programme • County extension staff- Capacity building • NGOs – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on mango production and marketing • Defining production programmes of mango • Levels of policy support
Suggestions for addressing the challenges	• Formation of production clusters • Aggregation of production to assume large scale-farming • Developing information hub • Conducting SWOT analysis • Development of policy briefs and advocacy
Lessons learned in up scaling if any	• Llow commitment by members • Failure to meet target volume due to side-sales
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – lack of trust among members • Environmental conditions – favorable condition for mango production • Policy conditions – need for infrastructural support
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Farmers,tradersand processors, agripreneurs
Estimated returns	Good prices and high turnovers leading to increased income
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is usually a men enterprise and women are generally discriminated when itcomes to formation of marketing groups • Women may have less access tomarketinginformation • Often women lack time to attend organized meetings due to their busy schedules • Women may be easy to be exploited by brokers • Women and youth have limited finances to pay services such as trainingunlike mendue to limited access tocreditfacilities • Youth and women are usually left out when key decisions are being made relating to the mango value chain
Gender related opportunities	• All gender, especially youth and womenstand to benefit with higher profit marginsthrough collective bargaining during marketing
VMG issues and concerns in development and dissemination, adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs may have limited participation and influence in rural producer organizations • VMGsmay have limited finances to pay services such as trainingdue to limited access tocreditfacilities • The VMG are exploited by middle mensince they sell their Mangoes products at the local market

VMG related opportunities	• There will be increased profit margins • The VMGs product will have access to both local and distance markets • Increased market information and channels for 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 areavailable
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 AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO- Dr. Wambua J. M.
Partner organizations	

GAPS

Further research

1. Profitable opportunities
2. Performance of marketing as a group

2.10.4 TIMP Name	**Profitability analysis – Reviewing performance of mango agro- enterprise**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of profitability analysis by farmers, leading to lack of comparison of costs and returns and therefore 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 mango agro-enterprise
Justification	Profitability analysis reviews the management success and sustainability of the mango business.It indicates areas of adjustment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers, agripreneurs..
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Record keeping of costs and returns • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – production and 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	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Inability of farmers to keep records • Use of non-costed family labour in mango production
Suggestions for addressing the challenges	• Inability of farmers to keep records – capacity building • Use of non-costed family labour in mango production – capacity building on how to cost family labour
Lessons learned in up scaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Awareness on record keeping • Environmental conditions – suitable for the increased production of mango • 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	Cost of participation in marketing forums
Estimated returns	Good prices and high turnovers leading to increased income
Gender issues and concerns in development and dissemination, adoption and scaling	• Women and youth are vulnerable to exploitation by the middle men • Women and youth are usually left out when key decisions are being made relating to the mango value chain • Women may not have time to attend organized meetings due to their busy schedules

	• Women and youth have limited finances to pay services such as training
Gender related opportunities	• Increased income • Sustainable mango business
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs may have limited informationon marketinghence being exploited by middle men • The VMGsmay be constrained to have access to external markets • The VMGshave limitedfinances which limits them frompaying for services such as trainings
VMG related opportunities	• Increased production and sales of mangoes by VMG • Improve livelihoods for the 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 areavailable
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 AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO - Dr. Wambua J. M
Partner organizations	

GAPS

Further research

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

2.10.5 Market research for Mango farmers

2.10.5 TIMP Name	**Market research for Mango farmers**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Knowledge asymmetries among the smallholder farmers leading to poor connectivity of smallholders to different markets,
What is it? (TIMP description)	Market research gathers information on the product buyer, demand, type required, minimum volume purchased, collective marketing volume, quality, packaging requirements, frequency

	of delivery, purchase price, means of payment and willing to buy from local farmers
Justification	Without market research the smallholder farmers will continue being market disintegrated, leading to low market participation
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders,processors, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Ability of farmers to increase production within their group • How the farmers are enabled to increase their production and sales (more technology, more land, more members) • The possibility of the farmers to work with other existing groups (available/not available) • Possibility of farmers to form new groups • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango 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	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Issues related to increasing production from existing group • Issues related to increasing production from increasing size of existing groups
Suggestions for addressing the challenges	• Issues related to increasing production from existing group – farmers reach their new production target from the group members and farmers investing in new technology to achieve new targets

	• Issues related to increasing production from increasing size of existing groups – the first group help new farmers to develop an enterprise plan and the new farmers to join the existing groups or form an associated group
Lessons learned in up scaling if any	• None
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	Cost of participation in research forrums
Estimated returns	Good markets and high turnovers leading to increased income
Gender issues and concerns in development and dissemination, adoption and scaling	• Woman and Youth may not have accessand control to productive resources such as land • Women sell small quantities of mangoes products due to limited finances to purchase large qualities • Women have less access tomarket information • Women and youth have limited access to education, training and extension services than men • Women are usually left out when key decisions are being made relating to the mango value chain
Gender related opportunities	• Increase in production and sales by youth and women • Increased market outlets for women and youth
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGsmay have limited access to market information • VMGsmay have limited access to education, training and extension services than men • VMGs are usually left out when key decisions are being made relating to the mango value chain
VMG related opportunities	• Increase in production and sales • Improved livelihoods
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 areavailable
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. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO- Dr. Wambua J. M.
Partner organizations	

GAPS

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

2.10.6 Contracted Mango production model

2.10.6 TIMP Name.	**Contracted Mango production model**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Market failure in Mango production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves investment by the private companies, extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.
Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access,increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, traders, extension,research institutions, farmer cooperative societies, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP)

	• Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of Mango • Production volume • Enforcement and bidding contract farming • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff- Capacity building, signing contract • NGOs – Capacity building • Private sector (local traders and exporters) – Contract party and beneficiaries • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Lack of information by part of the producers • Inadequate of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – Increase volume through increase in productivity • Lack of information by part of the producers – Capacity building • Inadequate policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	• Increased benefits
Social, environmental, policy and market conditions	• Social conditions – Conflicts with traditional farming

necessary for development and up-scaling	• Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management • Policy conditions – Policy in formulation and enforcement • Market conditions – volume, place, price, promotion, traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be covered/anticipated in the contract
Estimated returns	To be covered/anticipated in the contract
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is usually a men enterprise and women are generally discriminated in rural producer organizations. • 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 • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances to pay services unlike mendue to limited access tocreditfacilities • Women and youth have limited access to education, training and extension services than men
Gender related opportunities	• Increased market access, increased income, improved livelihood • Increase in production and sales by youth, females and males in the production of mango leading to food security and nutrition • Men and youth stand to benefit with higher profit margins through collective bargaining during transformative marketing
VMG issues and concerns in development and dissemination, adoption and scaling up	• VGMs have low finances due to limited access tocredit facilities • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs also have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	• Increased market access, increased income, improved livelihood • Increase in production and sales by youth, females and males in the production of mango leading to food security and nutrition • VMG stand to benefit with higher profit margins through collective bargaining during transformative marketing

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)	The guidelines for the contract farming are ready for up-scaling
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 - Dr. Wambua J. M
Partner organizations	

Gaps for further research

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

2.10.7 Marketing Innovation model

2.10.7 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	Farmers' failure to apply entrepreneurship while marketing mangoes leading to low prices
What is it? (TIMP description)	An entrepreneur farmer undertakes innovations plus finance and business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles would lead to unsuccessful farming as business
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers,extension, NGOs,researchers, agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print

	• Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services •
Critical/essential factors for successful promotion	• 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 mango varieties • A platform for interaction in mango 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	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Small-scale farming • Availability of information • Profitability in Mango farming • Lack of policy support
Suggestions for addressing the challenges	• Capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	• Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional methods • Environmental conditions – Use of pesticides and disposal • Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To depend on the model
Estimated returns	To depend on model execution and performance
Gender issues and concerns in development and dissemination, adoption and scaling	• Womenmay lackentrepreneurialskillsandcapacitytoengagein entrepreneurshipcompared with men

	• Women may lack knowledge tosavetheirmoneythatcanbe used in entrepreneurship • Womendonotusuallyapplyforloansthatcanbeusedto manage their businesses and increase their profits
Gender related opportunities	• Opportunities exist for women and youth to venture in entrepreneurship
VMG issues and concerns in development and dissemination, adoption and scaling up	• VGMs may have low finances due to limited access tocredit facilities • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs may have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	• Increased production and sales of Mango by VMGs leading to improved livelihood • Opportunities exist for VMGs to venture in entrepreneurship throughaffirmativeactionfundsthataregiventotheme.g. • Uwesofund
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 areavailable
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. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRI, Dr. Wambua J. M.
Partner organizations	

Gaps for further research

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

2.10.8 Internet/mobile marketing

2.10.8. TIMP Name	Internet/mobile marketing
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	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, Extension agents. Researchinstitutions. Farmercooperatives, agripreneurs.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in Mango production and profitability analysis • Levels of experiences in Mango production • Availability of information on Mango production and marketing • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders • Availability and access of internet
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of Mango production • County extension staff- Capacity building • NGOs – Capacity building

	• Private sector (local traders and exporters) – Buyers of Mango • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the Mango production and marketing and profitability • Internet connectivity • Insufficient levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Capacity building • Delivery of produce to the designated centres • Capacity building and sensitization to appreciate need for consolidation of produce • Developing information hubs • 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	Depend on the channels and softwares used
Estimated returns	Depend on the channels and softwares used, volumes traded and the profit margins
Gender issues and concerns in development and dissemination, adoption and scaling	• Womenhavelessaccesstotherequiredtoolssuchasphones and computer • Women could be more illiterate and therefore may not use the ICTsas would be expected than men
Gender related opportunities	• Improved accessibility of information duel to availability of mobile phones by youth, males and females • 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	• VMGsmay havelessaccesstotherequiredtoolssuchasphones and computer than men • VMGscould have literacy challenges andtherefore cannotusetheICTs platforms as desired
VMG related opportunities	• Opportunitiesexist for VMGs tousethe ICTtools if they have the appropriate skills.
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 areavailable
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The platforms are ready for up-scaling
G: Contacts	
Contacts	Dr. Wambua, J.M.
Lead organization and scientists	KALRO-AMRI-Katumani
Partner organizations	

Gaps for further research

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

2.11 Mango Agricultural Policy Options

2.11.1 National Agricultural policy strategy framework

2.11.1. 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	Smallholder farmers' agency has been largely neglected in the Agricultural policy making in Kenya. The smallholder farmers are framed as having no innovations or insights to offer. Indeed, they are considered to have little agency beyond the adoption of modernizing innovations that are believed to transform agriculture and build livelihoods.
What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, providing policy objectives and instruments.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers'

	perspectives and knowledge can be included in policy going forward
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Policymakers, Traders,Processingindustries, Extension,NGOs, Researchinstitutions, Agripreneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific Mangoes-based policies • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Mangoes policies to support production and marketing • County extension staff- Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Mangoes 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	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• **Value Chain**: Mango yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • **Standards:** Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted. • **Aggregation**: Aggregation models including cooperatives—suffered after the downturn in Mangoes production, wherein many farmers abandoned Mangoes

	production. These weak organizations provide few services to farmers while providing limited bargaining power. • **Financial Incentives**: The government provides only limited support to Mangoes 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 Mangoes 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 Mangoes 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 Mangoes 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	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of Mangoes where there is no value chain • Environmental conditions – Use of pesticides • Policy conditions – Lacking specific Mango policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined

Estimated returns	To be determined
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequaterepresentationofyouthandwomeninpolicy development forums at all levels • Inadequate representation of youth and women in the policy validation process
Gender related opportunities	• Opportunitiesexistforadequateyouth and womenrepresentationinthe policy formulationandvalidationprocessiftheyfocusand strategize well
VMG issues and concerns in development and dissemination, adoption and scaling up	• InadequaterepresentationofVMGsinpolicy development forums at all levels • Inadequate representation of VMGs in the policy validation process
VMG related opportunities	• OpportunitiesexistforVMGsparticipationinalllevelsof policyformulationsincethereare policyframeworksto support their participation
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation and 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- Dr. Wambua J. M.
Partner organizations	

Gaps for further research

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

2.11.2 County Integrated Development Planning

2.11.2 TIMP Name	**County Integrated Development Planning**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of centralizing the smallholder agency and voices in planning agricultural development issues in Kenya

What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in mango production, marketing and processing are considered.
Justification	Failure to consider mango issues during planning would lead to omission in the development funding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Traders • Processing industries • Extension • NGOs • Research institutions • Policy makers • Agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of agricultural policies and specific Mango-based policies • Issues in Mango business • Specific policy objective statement • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango value chain stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Mango policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Mango policies to support production and marketing • 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	All mango growing counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
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 Mango value chain • Mango production are specific to agro-ecological zones and not all the Counties in Kenya grow Mango
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organizations • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Mango value chain – strengthening mango value chain • Mango production are specific to agro-ecological zones and not all the counties in Kenya grow mango – diversification of mango
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptability of the policies • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Mango policy • Market conditions - Poor market infrastructure • Willingness of stakeholders to participate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs include fertiliser/manure, pesticides & fungicides, labour cost, transport and packaging materials. Depending on the number of trees, the total variable costs are KES 5,790, 13,775, 53,750 and 105,825 for <50, 51-300, 301-800 and 801-3000 trees, respectively.
Estimated returns	Mango production has good returns and actors along the value chain all operate profitably. Depending on the type of mango, the average price in Kenya is KES 125.5 per kg. Therefore, a smallholder farmer with 50 trees can harvest approximately 10,000 pieces of mangoes per season. If the farmers sell the fruits to the brokers at the farm gate price of Sh3, the fruits will fetch a paltry Sh. 30,000 per season. In Lower Eastern region, The net profit margins for mango farmers ranged between 49% (KES4,950) to 92% (KES1,386,850) for the small- and large-scale farmers respectively.
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is mostlyan enterprise dominated by men. In contrast, women are generally discriminated against in access to information

	• Women and youth may have limited access to productive resources such as land, equipment and inputs • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances • Women and youth may have limited access to education, training and extension services than men • Women and youth may be left out when key decisions are being made relating to the mango value chain
Gender related opportunities	• Supporting youth, females and males in the production and marketing of Mango. • Increased income by youth female and male • Increased employment by youth, females and males
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs may be excluded from decision making in development and dissemination activities • VMGs may have limited participation and influence in trainings and workshops • VMGs may have limited access to assets, resources and services, required to join • The VMGs may have limited access to external markets
VMG related opportunities	• Supporting VMGs the production and marketing of Mango. • 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	1. Training factsheets, 2. Manuals 3. https://cog.go.ke/20-the-council-of-governors/484-county-integrated-development-plans
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. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO - Dr. Wambua J. M.
Partner organizations	County governments

Gaps

Further research is required in the following;

1. Adoption of policy options

2. Equity distribution among the stakeholders
3. Productivity levels among the smallholder farmers
4. Farmer accessibility to production inputs

2.11.3 Policy instruments related to Mango

2.11.3 TIMP Name	Policy instruments related to Mango
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Weak policy instruments lead to market failure for both inputs and outputs
What is it? (TIMP description)	Agricultural policy is implemented through instruments. Therefore, the policy instruments are the means to achieve policy objectives
Justification	Methods of attempting to achieve policy objectives may take a wide variety of forms. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability effect, will also have some impact on the other objectives
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Traders • Processing industries • Extension • NGOs • Research institutions • Policy makers • Agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of policy objectives • Availability of policy instruments • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango 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	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
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 Mango value chain • Mango production are specific to agro-ecological zones and not all the Counties in Kenya grow Mango
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 Mango value chain – strengthening Mango value chain • Mango production are specific to agro-ecological zones and not all the counties in Kenya grow mango – diversification of mango
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptability of the policies • Environmental conditions – lack of a comprehensive land use policies • Policy conditions – Lacking specific mango policies • Market conditions - Poor market infrastructure • Willingness of stakeholders to participate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs include fertiliser/Manure, Pesticides & fungicides, labour cost, transport and packaging materials. Depending on the number of trees, the total variable costs are KES 5,790, 13,775, 53,750 and 105,825 for <50, 51-300, 301-800 and 801-3000 trees, respectively.
Estimated returns	Mango production has good returns and actors along the value chain all operate profitably. Depending on the type of mango, the average price in Kenya is KES 125.5 per kg. Therefore, a smallholder farmer with 50 trees can harvest approximately

	10,000 pieces of mangoes per season. If the farmers sell the fruits to the brokers at the farm gate price of Sh3, the fruits will fetch a paltry Sh. 30,000 per season. In Lower Eastern region, The net profit margins for mango farmers ranged between 49% (KES4,950) to 92% (KES1,386,850) for the small- and large-scale farmers respectively.
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is mostlyan enterprise dominated by men. In contrast, women are generally discriminated against in access to information • Women and youth may have limited access to productive resources such as land, equipment and inputs • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances • Women and youth may have limited access to education, training and extension services than men • Women and youth may be left out when key decisions are being made relating to the mango value chain
Gender related opportunities	• Production-increasing by youth, females and males. • Increased resource use in agricultural production and processing by youth, women and men • Sustainability in Mango farming by youth, women and men
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs maybe excluded from decision making in development and dissemination activities • VMGs mayhave limited participation and influence in trainings and workshops • VMGs may have limited access to assets, resources and services, required to join • The VMGs may have limited access to external markets
VMG related opportunities	• Efficiency and access to product markets by VMGs. • Increased income by VMGs • Increased employment by VMGs • Sustainability
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	1. Training factsheets 2. Manuals 3. https://www.kalro.org/sites/default/files/mango-tot.pdf
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. Machakos

	Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO - Dr. Wambua J. M
Partner organizations	

Gaps

Further research required on the following areas;

1. Validation of policy instruments
2. Farmer accessibility to production inputs markets for mangos
3. Farmers accessibility to mango markets

2.11.4 Policy cycle

2.11.4 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	Development of agricultural policies that support the mango value chain. The polcies should be reviwedfrequently to reflect the current situation.
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 mango? 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 • Policy makers • Agri-preneurs
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications – posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of stakeholders • The stages of problem emergence, formulation, implementation and evaluation • Applied and adaptive Research to test, validate and release improved mango varieties • A platform for interaction in mango 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	All mango growing Counties including Muranga, Kirinyaga, Nandi, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on issues • Poorly established Mango 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 Mango value chain – strengthening Mango value chain
Lessons learned in up scaling if any	None

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability of the policies • Environmental conditions – lack of a comprehensive land use policies • Policy conditions – Lacking specific mango policies • Market conditions - Poor market infrastructure • Willingness of stakeholders to participate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs include fertiliser/Manure, Pesticides and fungicides, labour cost, transport and packaging materials. Depending on the number of trees, the total variable costs are KES 5,790, 13,775, 53,750 and 105,825 for <50, 51-300, 301-800 and 801-3000 trees, respectively.
Estimated returns	Mango production has good returns and actors along the value chain all operate profitably. Depending on the type of mango, the average price in Kenya is KES 125.5 per kg. Therefore, a smallholder farmer with 50 trees can harvest approximately 10,000 pieces of mangoes per season. If the farmers sell the fruits to the brokers at the farm gate price of Sh3, the fruits will fetch a paltry Sh. 30,000 per season. In Lower Eastern region, The net profit margins for mango farmers ranged between 49% (KES 4,950) to 92% (KES 1,386,850) for the small- and large-scale farmers respectively.
Gender issues and concerns in development and dissemination, adoption and scaling	• Mango is mostlyan enterprise dominated by men. In contrast, women are generally discriminated against in access to information • Women and youth may have limited access to productive resources such as land, equipment and inputs • Women have less access to agricultural information, technology and knowledge • Women and youth have limited finances • Women and youth may have limited access to education, training and extension services than men • Women and youth may be left out when key decisions are being made relating to the mango value chain
Gender related opportunities	• Incorporation of issues generated by the youth, females and males. • Implementation of policy cycle
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs maybe excluded from decision making in development and dissemination activities • VMGs mayhave limited participation and influence in trainings and workshops • VMGs may have limited access to assets, resources and services, required to join • The VMGs may have limited access to external markets
VMG related opportunities	• Reduction of VMGs problems in the production and marketing of Mango. • Involvement of VMGs in the implementation of policy

E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	1. Training factsheets 2. Manuals 3. https://www.kalro.org/sites/default/files/mango-tot.pdf
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. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO- Dr. Wambua J. M.
Partner organizations	

Gaps

Further research required on the following areas;

1. Validation of policy cycles
2. Farmer accessibility to production inputs markets for mangos
3. Farmers accessibility to mango markets

National Agricultural Value Chain Development Project (NAVCDP)
Ministry of Agriculture and Livestock Development
Capital Hill, Cathedral Road, Nairobi
P. O. Box 8073-00200 Kenya
info@navcdp.go.ke
www.navcdp.go.ke

Kenya Agricultural and Livestock Research Organization
KALRO Secretariat
P O Box 57811-00200
Nairobi, KENYA
Email: directorgeneral@kalro.org
Tel. No(s): +254-722206986/ +254-733333223
Web: www.kalro.org